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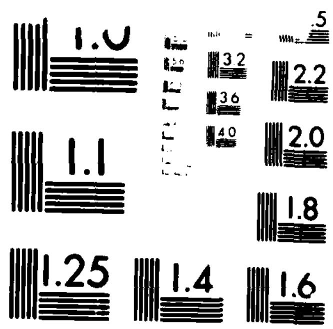
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INSTALLATION RESTORATION PROGRAM
PHASE I: RECORDS SEARCH

PETERSON AIR FORCE BASE
COLORADO

Prepared for:

UNITED STATES AIR FORCE
HQ AFESC/DEVP
Tyndall AFB, Florida

and

HQ SPACECMD
Peterson AFB, Colorado

Submitted by:

REYNOLDS, SMITH AND HILLS, INC.
Jacksonville, Florida

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.
Denver, Colorado

August 1985

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This report has been prepared for the U.S. Air Force by Environmental Science and Engineering, Inc., for the purpose of aiding in the implementation of the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the publishing agency, the U.S. Air Force, or the Department of Defense.

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A search of USAF records and interviews with past and present base personnel was conducted to identify past hazardous waste generation and disposal practices at Peterson AFB, CO. The base is located on the eastern edge of Colorado Springs, CO on the high plains east of the front range of the Rocky Mountains. Seven sites were identified and inspected as potential hazardous waste sites. Five of the sites were selected for further investigation based upon potential for contaminant release and environmental degradation. Fuel and solvent spills and disposal account for the majority of the environmental concerns. Follow on recommendations include the sampling and analysis of soils and ground waters at five sites to determine the extent of contamination if any.

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EXECUTIVE SUMMARY

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous material disposal sites on DOD property, control the migration of hazardous contaminants, and control hazards to health or welfare that may result from these past disposal operations. This program is called the Installation Restoration Program (IRP). The IRP has four phases consisting of Phase I, Initial Assessment/Records Search; Phase II, Confirmation and Quantification; Phase III, Technology Base Development/Evaluation of Remedial Action Alternatives; and Phase IV, Operations/Remedial Actions. The IRP will be the basis for response actions on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, Executive Order 12316, and 40 CFR 300 Subpart F (National Oil and Hazardous Substances Contingency Plan). CERCLA is the primary legislation governing remedial action at past hazardous waste disposal sites. Environmental Science and Engineering, Inc. (ESE) was retained by the United States Air Force (USAF) to conduct the Phase I, Initial Assessment/Records Search for Peterson Air Force Base (PAFB) and North American Aerospace Defense Command (NORAD) Cheyenne Mountain Complex (NCMC) under Contract No. F08637-83-G0010-5003.

METHODOLOGY

The methodology utilized in the Peterson Complex records search began with a review of past and current industrial operations conducted at the base. Information was obtained from available records, such as shop files and real property files, as well as interviews with past and current base employees from the various operating areas. The next step in the activity review was to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the various operations on the base. A ground tour of the identified sites were then made by the ESE Project Team to gather site-specific information. A decision was then made, based on all of the above information, regarding the potential for hazardous materials contamination at any of the identified sites.

INSTALLATION DESCRIPTION

The Peterson Complex is an Air Force community located in El Paso County, Colorado and is the home of Peterson Air Force Base (PAFB), Headquarters NORAD, Headquarters Space Command (SPACECMD), Headquarters Aerospace Defense Command (ADCOM), and the NCMC.

PAFB is the complex hub and is located approximately seven miles east of downtown Colorado Springs, Colorado. PAFB is comprised of fee and leased land parcels occupying some 1176 acres. The majority of acreage (992 acres) is provided under lease agreements between the City of Colorado Springs and the U.S. Government. The remaining 184 acres are fee title and were acquired through a land exchange between the U.S. Government and the City of Colorado Springs. The City of Colorado Springs retains use rights for the general aviation complex.

The NCMC is located on and within Cheyenne Mountain and is approximately five miles south of Colorado Springs. The facility occupies some 519 acres of fee title and leased land.

ENVIRONMENTAL SETTING

The climate of PAFB, as derived from recorded data for the City of Colorado Springs is classified as mid-latitude, semi-arid and characterized by hot summers, cold winters, and relatively light rainfall. The mean maximum temperature in the area is 43.5 degrees Farenheit (°F) in January and 88.2 °F in July. The mean minimum temperatures are 14.9 °F in January and 57.2 °F in July. The prevailing wind direction at PAFB is from the north, with monthly average speeds of 9.3 miles per hour (mph) to 12.1 mph. Precipitation in the area varies with specific locations due to elevation and terrain difference. Annual averages are 12 to 15 inches per year (in/yr), with approximately 80 percent falling between April and September. Average annual snowfall in the region is 36.2 in/yr. Snow and sleet usually occur from September to May, with the heaviest snowfall in March and possible trace accumulations as late as June.

PAFB is in the Colorado Piedmont section of the Great Plains Physiographic Province. Elevations on the base range from 6,000 feet (ft) to 6,300 ft, with a surface slope generally to the southwest.

The three major land forms in the Colorado Springs area are low plains, high plains, and low hills. Southwest of PAFB, the area is characterized by low plains dissected by tributaries to Fountain Creek. PAFB itself lies in an area dominated by gently to strongly rolling high plains. The area west and north of PAFB is dominated by the low hills, which are characterized by rounded to sharp-crested hills, rocky surfaces, with occasional gently rolling uplands and shallow canyons with nearly vertical walls.

PAFB and NCMC are within the Arkansas River Basin. Fountain Creek, a perennial stream originating 11 kilometers (km) northwest of Pikes Peak, flows southeast through Colorado Springs west of PAFB and joins the Arkansas River in the vicinity of Pueblo. This creek and its tributaries provide surface drainage within PAFB and NCMC.

Drainage from the developed areas of PAFB is captured in gutter inlets and flows through underground pipes to one of several outfalls. The airfield drains through surface ditches. The majority of the developed area and the flightline drains to the golf course pond and is subsequently used for irrigation. The northwest corner of the base drains into East Fork Sand Creek. Remaining airfield areas drains through unnamed intermittent channels tributary to Fountain Creek.

PAFB is located on the southwestern edge of the Denver Basin. This basin is an asymmetric structural depression with a gentle eastern and a steep western flank. The basin axis trends north-south, nearly paralleling the Front Range. Over 13,000 ft of Phanerozoic strata are contained by the basin which covers 60,000 square miles of Colorado, Wyoming, Kansas, and Nebraska. NCMC lies within the Laramie Front Range.

PAFB rests on the Cretaceous Foxhills sandstone which represents the last marine sandstone deposited in this region. In latest Cretaceous time, sedimentary patterns were significantly changed by the initiation of the

most important tectonic event since Pre-Paleozoic. This event was the Laramide Orogeny which was characterized by vertical uplifts, compressive folds and faults, thick continental deposits, and volcanism.

The Late Tertiary saw the establishment of present drainage patterns and geomorphic features, basin filling, and volcanism. The Dawson and the overlying arkose were despoited during this period.

All four series of soils located on PAFB may be generally characterized as sandy soils originating from the weathering of arkosic sedimentary units, having neutral pHs, and high permeability. Major associations are Blakeland, Blendon, Ellicott, and Truckton.

The primary aquifers underlying PAFB are Quaternary alluvium and the underlying Laramie-Foxhills Formations. Deeper formations of secondary importance include the Dakota Group, Lyons Sandstones, Fountain Formation, and also Pre-Cambrian granites. The alluvium is the most permeable aquifer, with 200 times the capacity to accept recharge water than the Laramie-Foxhills aquifer.

Recharge of aquifers occurs in instances where the formation intersects the surface, or is buried by water-bearing strata. Methods of recharge include: percolation of surface precipitation, stream loss into underlying sediments, migration of water from one formation to another, and recharge from man-induced conditions.

FINDINGS

Industrial operations at PAFB are related to maintenance of aircraft, heavy equipment, motor vehicles, and base facilities. The major units involved in maintenance activities are the 901 CAMS, 1001 CES, and 1001 TRNSS. These units provide a variety of services including oil and fluids changes, minor engine maintenance, painting, radiator repair, and hydraulic system repair. Industrial operations at NCMC are limited to operation and maintenance of the complex, which involves primarily electrical generation and distribution and interior painting.

The mission of PAFB has changed several times over the years, and thus the specific maintenance operations and the level of activity have changed as well. In general, the industrial operations have always been those associated with aircraft and vehicle operations such as painting, engine repair, and aircraft systems maintenance. However from approximately 1960 to 1975, PAFB had flying missions which resulted in a higher level of aircraft operations than at present. The primary aircraft used during this period were the T-33 and T-37. The number of aircraft at PAFB rose gradually from 1960, peaking at 98 in 1968 and then declining. During this same period, the engine shop in Building 502 served as a depot level maintenance facility.

The main types of waste generated at PAFB and NCMC are fuel, oils and solvents, and paints and paint strippers. Waste fuel, oil solvents include JP-4, engine oil, PD680, and MEK which are derived primarily from periodic maintenance and engine repair operations. Waste consisting of paint residue, strippers and thinner is generated by the parts, and vehicle painting operations.

Disposal practices used before 1960 were undocumented and difficult to substantiate. It is known that the original base construction included a number of septic tanks and dry wells, presumably for sewage disposal and floor drainage. In 1944, the septic tanks were abandoned, and the system was connected to the Colorado Springs sewage treatment plant. By 1956, the wet wells were abandoned, and drainage from the flightline areas was connected to an "industrial drain line". This line transported drainage from inside hangars and maintenance areas to the south end of the flightline. Flow was passed through a large septic tank used as an oil water seperator and then discharged into a leach field located in the present golf course. The industrial drain was connected to the sanitary sewer system in 1976.

Solid waste disposal in the early years consisted of burial in a series of landfills. The first two of these were located in the northwest corner of the base. They were used from 1953 to 1961, and possibly earlier. The third site is on the south boundary and was used until 1972, when solid

waste disposal was contracted out. Very little waste segregation was practiced, and no controls were placed on materials buried in the landfills. However, during the period of landfilling onbase both the industrial drain line and the firefighter training area were used for disposal of liquid waste. In addition, contract sale of waste oil and mixed flammable liquids was initiated in the early 1960's. Thus, disposal of liquid waste was probably limited to incidental dumping of small containers.

By 1980, the existing procedures for segregating waste and contract disposal through DPDO at Ft. Carson were being implemented. Sale of mixed liquids was discontinued according to contractor specification for materials acceptable for recycling. Fuel used for firefighter training was restricted to JP-4 supplied through the fuels management office. These procedures resulted in elimination of onbase waste disposal, with the exception of construction rubble placed at the Old Southeast Landfill.

CONCLUSIONS

The investigation identified eight areas of potential contamination associated with the Peterson Complex. Seven sites were located within the present PAFB boundaries (Figure ES-1) and resulted from handling and disposal of industrial and/or hazardous waste. The eighth area is the oil/water seperator and drainage discharge from NCMC.

Of the eight areas of potential contamination identified, five were determined to require rating with the Hazard Assessment Rating Methodology (HARM) system, based on the decision tree presented in Figure 1.3-1. The storm sewers, Fuel Yard, and NCMC oil/water seperator were eliminated at this point due to the lack of need for further IRP action. HARM ratings are summarized in Table ES-1.

East Fork Sand Creek Landfill #1 (Site 1)

This location at the northwest corner of the base was originally a gravel pit. It was used as a general purpose landfill from the late 1940's until 1953 or 1954. It is located adjacent to an alluvial channel where contact with ground water is indicated. Although disposal of industrial waste was reportedly limited, potential exists for contamiant migration, primarily

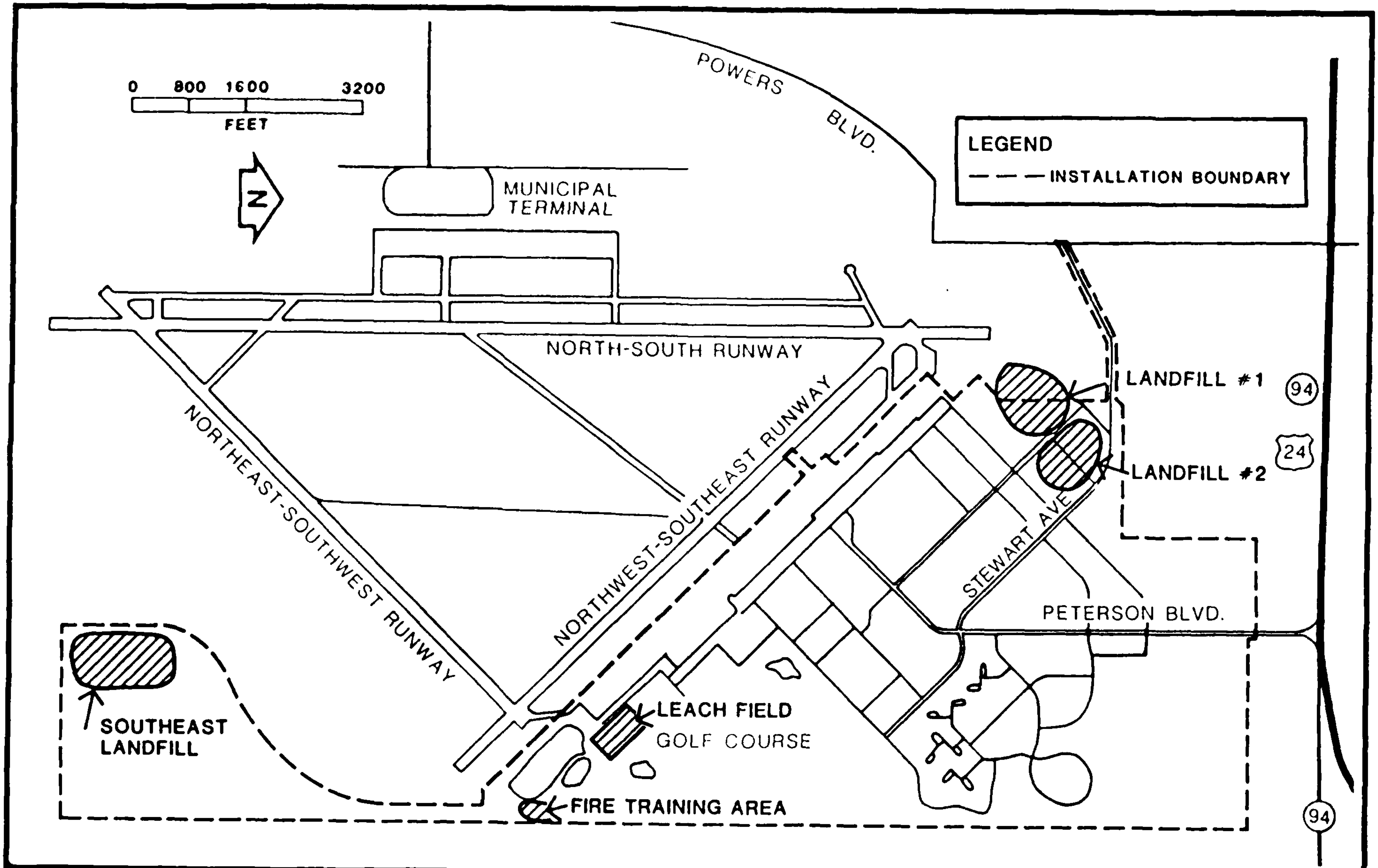


Figure ES-1
AREAS OF POTENTIAL CONTAMINATION

INSTALLATION RESTORATION PROGRAM
Peterson Air Force Base

Table ES-1. Summary of HARM Scores

Rank	Site	Receptors Subscore	Waste Characteristics Subscore	Pathway Subscore	Waste Management Factor	Total Score
1	Landfill #1	59	37	80	1.0	59
2	Landfill #2	59	37	80	1.0	59
3	East Boundary Leach Field	33	80	42	1.0	52
4	Firefighter Training Area #1	31	48	35	1.0	38
5	Southeast Landfill	31	20	35	1.0	29

Source: ESE, 1984.

involving solvents, oils, metals, and pesticides. This site scored 59 on HARM.

East Fork Sand Creek Landfill #2 (Site 2)

Located adjacent to Landfill #1, this site has a similar disposal history and geohydrologic conditions. It was operated from 1954 to 1961. This site was partially excavated during subsequent construction of Building 1324, which now occupies the site. Potential for contaminant migration of solvents, oils, metals, and pesticides exists. This site scored 59 on HARM.

East Boundary Leach Field (Site 3)

Used as a disposal facility for flow from the industrial drain line from 1956 to 1978, this site was subsequently regraded during golf course construction. Local ground water conditions are unclear. Potential exists for contaminant migrations by solvents, oils, metals, and pesticides. This site scored 52 on HARM.

Firefighter Training Area #1 (Site 4)

Firefighter training exercises were conducted in this shallow, unlined pit until 1977. Exercises were generally conducted using JP-4 as fuel. However, other liquids including waste oils and solvents were sometimes included. Local ground water conditions are somewhat uncertain, but no major aquifers or alluvial channels are present. Soil contamination with oils and solvent is likely. This site scored 38 on HARM.

Southeast Landfill (Site 5)

This site began operation in 1962 as a general purpose trench and cover landfill. In 1972, contract hauling of solid waste began, and subsequent landfilling was largely limited to construction rubble. Local ground water conditions are somewhat uncertain, but no major aquifers or alluvial channels are present. Potential for contaminant migration involves oils, solvents, metals, and pesticides. This site scored 29 on HARM.

RECOMMENDATIONS

Table ES-2 summarizes recommendations for Phase II investigation at PAFB.

Table ES-2. Summary of Recommended Monitoring for PAFB Phase II Investigations.

Site	HARM Score	Recommended Sampling	Recommended Analysis
Landfill #1 Landfill #2	59 59	Three wells downgradient; Two wells upgradient; Water and sediment samples from Sand Creek upstream and downstream.	Hydrocarbons, Solvents, Metals, PCB's, Pesticides
East Boundary Leachfield	52	Soil samples to six foot depth (or bottom of pit) in grid over area.	Hydrocarbons, metals
Firefighter Training Area #1	38	Soil samples to six foot depth (or bottom of pit) in grid over pit.	Hydrocarbons, PCB's Pesticides
Southeast Landfill	29	Three boundary wells Two upgradient wells Possible use of vadose zone monitoring.	Hydrocarbons Solvents Metals PCB's Pesticides

Source: ESE, 1984.

1.0 INTRODUCTION

1.1 BACKGROUND

Due to its primary mission, the U.S. Air Force (USAF) has long been engaged in operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations and contents of disposal site and take action to eliminate the hazards in an environmentally responsible manner. The primary Federal legislation governing disposal of hazardous waste is the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. Under Section 6003 of the Act, Federal Agencies are directed to assist the U.S. Environmental Protection Agency (EPA) under Section 3012, state agencies are required to inventory past disposal sites and make the information available to the requesting agencies. To assure compliance with these hazardous waste regulations, the Department of Defense (DOD) developed the Installation Restoration Program (IRP). The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated December 11, 1981, and implemented by USAF message, dated January 21, 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the IRP. DOD policy is to identify and fully evaluate suspected problems associated with past hazardous contamination and to control hazards to health and welfare that resulted from these past operations. The IRP will be the basis for response action on USAF installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as clarified by Executive Order 12316, and 40 CFR 300 Subpart F (National Oil and Hazardous Substances Contingency Plan). CERCLA is the primary legislation governing remedial action at past hazardous waste disposal sites.

1.2 PURPOSE, AUTHORITY, AND SCOPE OF THE ASSESSMENT

The IRP has been developed as a four-phase program, as follows:

- Phase I - Initial Assessment/Records Search
- Phase II - Confirmation and Quantification
- Phase III - Technology and Base Development
- Phase IV - Operations/Remedial Actions

The Phase I portion of an IRP investigation at USAF facilities located in an around Colorado Springs, Colorado, was performed by Environmental Science and Engineering, Inc. (ESE). The installations, collectively referred to as the Peterson Complex, include Peterson Air Force Base (PAFB), the Chidlaw Building, and the North American Aerospace Defense Command (NORAD) Cheyenne Mountain Complex (NCMC). Review activities were directed to PAFB and NCMC as the Chidlaw Building, while administrative home of Headquarters NORAD, and Space Command (SPACECMD) is under auspices of the General Services Administration (GSA) and therefore was not evaluated. Project funding was provided by the Air Force SPACECMD.

Phase I objectives were to identify areas of environmental contamination resulting from past waste disposal practices and assess the potential for possible contaminant migration. In order to successfully accomplish this task specific actions were undertaken. The activities included:

1. Review of site records;
2. Interviews with personnel familiar with past generation and disposal activities;
3. Inventory of wastes;
4. Determination of estimated quantities and location of current and past hazardous waste treatment, storage, and disposal;
5. Definition of the environmental setting at the base;
6. Review of past disposal practices and methods;
7. Performance of field and aerial inspections;
8. Gathering of pertinent information from federal, state, and local agencies;
9. Assessment of potential for contaminant migration; and
10. Development of conclusions and recommendation for follow-on.

ESE performed the onsite portion of the records search during August 1984. The following team of professionals was involved:

- William G. Fraser, P.E., Environmental Engineer, nine years of professional experience.
- Kathryn L. Kawecki, Geologist, five years of professional experience.

- o David H. Stephens, Geologist, eight years of professional experience.

Detailed information on these individuals is presented in Appendix B. This report provides a summary and assessment of information evaluated during Phase I of the IRP investigation and presents recommendations for necessary Phase II action.

1.3 METHODOLOGY

Initial efforts in the PAFB and NCMC records search were directed to a review of past and present operations involved in the handling, testing, production, or disposal of toxic and hazardous wastes. Information was obtained from numerous sources including various base records (historian, engineering, environmental, maintainance, real estate, grounds, etc.) as well as interviews with current and former Air Force and civilian base personnel and employees. A listing of interviewees by position with approximate years of service is presented in Appendix C.

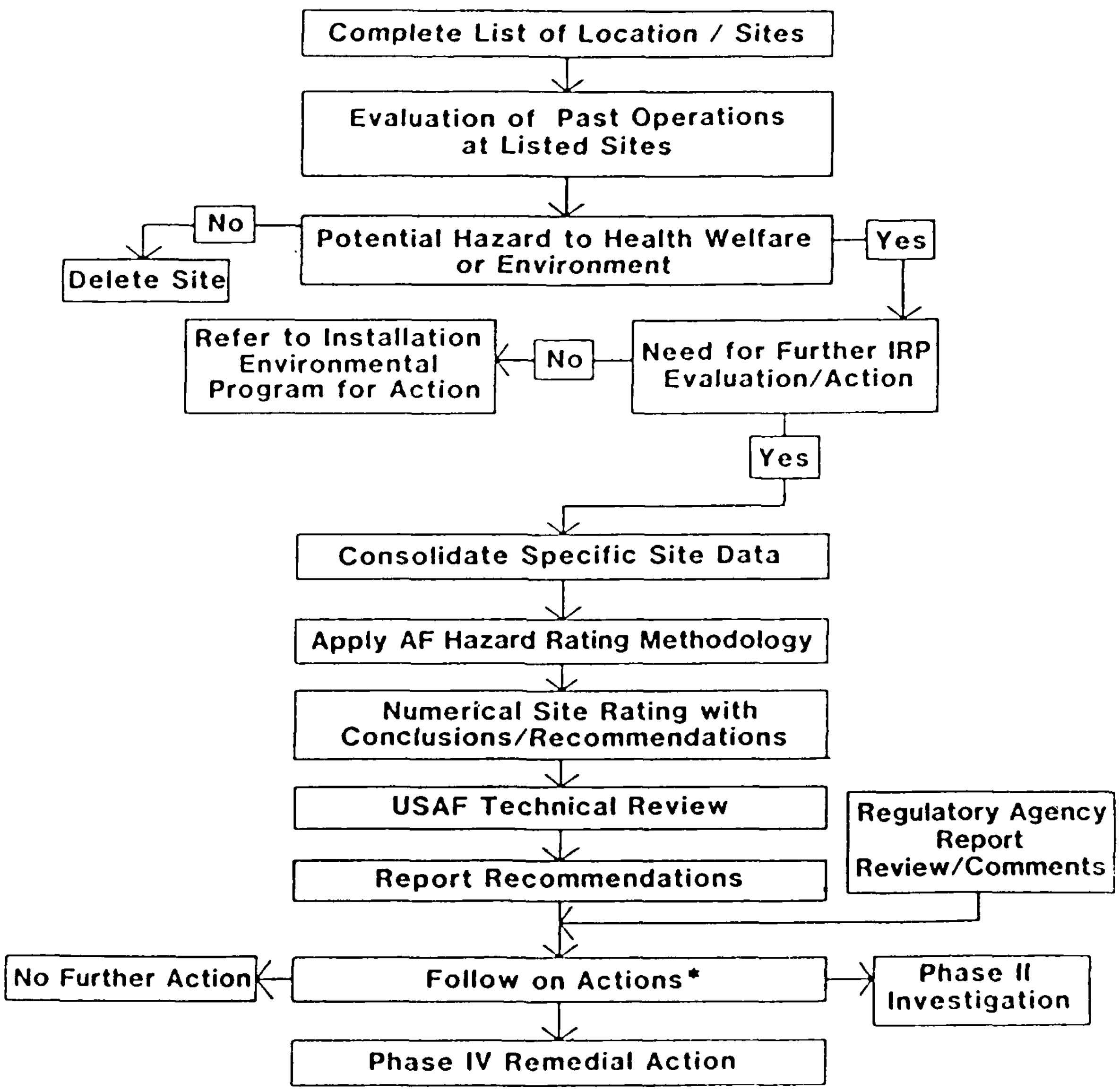
Following the determination of waste generating operations, an attempt was made to ascertain the management practices, current and past, regarding the use, storage, treatment, and disposal of hazardous materials produced from the various activities. As a result, all known disposal sites and potential contaminated areas were identified.

A ground tour and helicopter overflight of the identified sites was then made by the ESE Project Team to gather site-specific information including:

1. Visual evidence of environmental stress;
2. The presence of nearby drainages ditches or surface water bodies; and
3. Visual inspection of these water bodies for any obvious signs of contamination or leachate migration.

Utilizing the process illustrated in Figure 1.3-1, a determination based on the information acquired, was made regarding contamination potential at the identified sites. If no potential existed, the site was deleted

PHASE I INSTALLATION RESTORATION PROGRAM
RECORDS SEARCH FLOW CHART



*Beyond Scope of Phase I

SOURCE: AFESC, 1984

Figure 1.3-1
IRP RECORD SEARCH FORMAT

INSTALLATION
RESTORATION PROGRAM
Peterson Air Force Base

from further consideration. If potential for contamination was present, the potential for migration of the contaminant was assessed based on site-specific conditions. If there were no further environmental concerns, the site was deleted. If the potential for contaminant migration was considered significant, the site was evaluated and prioritized using the HARM. A discussion of the HARM system appears in Appendix F. HARM sites were also reviewed with regard to future land use restrictions.

2.0 INSTALLATION DESCRIPTION

2.1 LOCATION/SIZE

The Peterson Complex is an Air Force community located in El Paso County, Colorado (Figure 2.1-1) and is the home of PAFB, Headquarters NORAD, Headquarters Space Command (SPACECMD), Headquarters Aerospace Defense Command (ADCOM), NCMC.

PAFB (Figure 2.1-2 and 2.1-3) is the hub of the complex and is located approximately seven miles east of downtown Colorado Springs, Colorado. PAFB is comprised of fee and leased land parcels occupying some 1,176 acres. The majority of acreage (992 acres) is provided under lease agreements between the City of Colorado Springs and the U.S. Government. The remaining 184 acres are fee and were acquired through a land exchange between the U.S. Government and the City of Colorado Springs. The City of Colorado Springs retains use rights for the general aviation complex.

The NCMC (Figure 2.1-4) is located on and within Cheyenne Mountain and is approximately five miles south of Colorado Springs. The facility occupies some 519 acres of fee title and leased land.

2.2 HISTORY

The history of PAFB dated from 1925 when the City of Colorado Springs established an airdrome on a relatively flat parcel of land approximately five miles east of the city. The area chosen by those who governed the then quiet resort community was in sharp contrast to the mountainous Front Range of the Colorado Rockies which rises to 14,110 ft at the summit of Pikes Peak, a landmark easily visible from the airdrome site. Actual construction of the base adjacent to the municipal airport began in 1942 as American participation in World War II (WWII) increase. On May 7, 1942, the Army established a support command at the base under the Army Air Force. In June of 1942, the 2nd Air Force assumed command of the base, and on March 3, 1943, the airdrome was officially named Peterson Army Air Field in tribute to Lt. Edward J. Peterson, a photo reconnaissance pilot who had died shortly after the crash of his Lockheed F-4 (the photo version of the P-38) at the base. In that same month, the

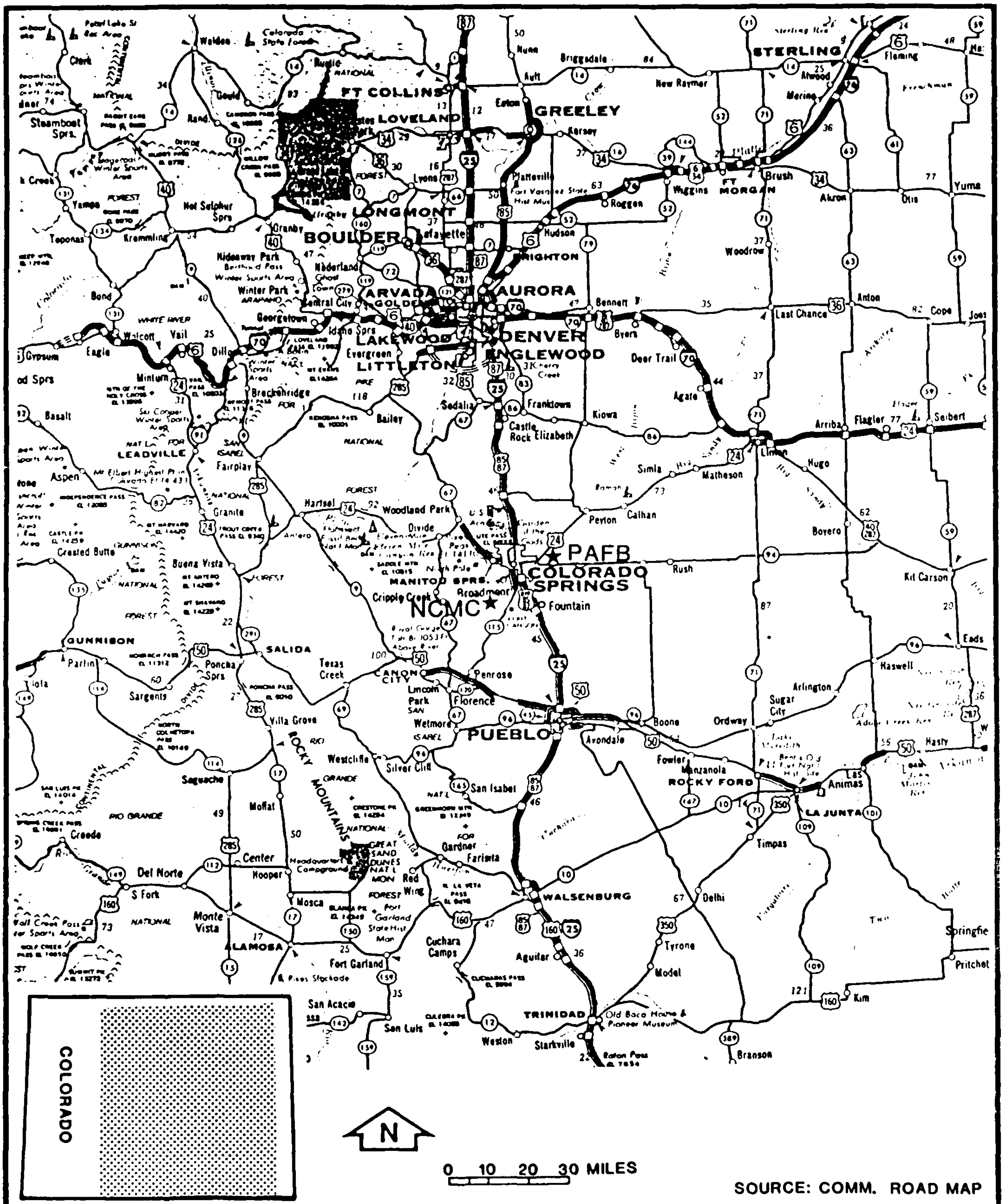


Figure 2.1-1 LOCATION MAP-PAFB and NCMC	**INSTALLATION RESTORATION PROGRAM** **Peterson Air Force Base**

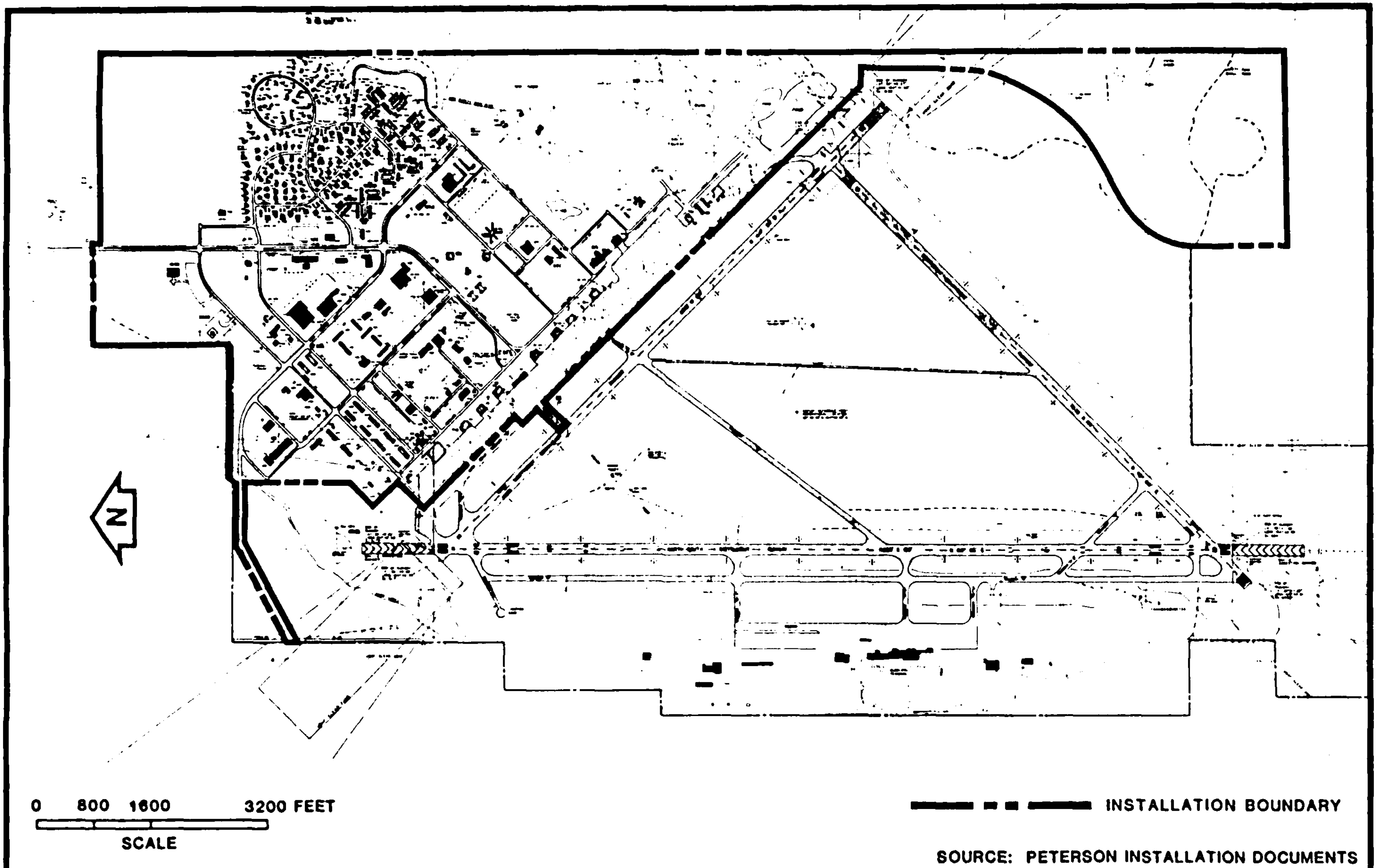


Figure 2.1-2
SITE PLAN - PAFB

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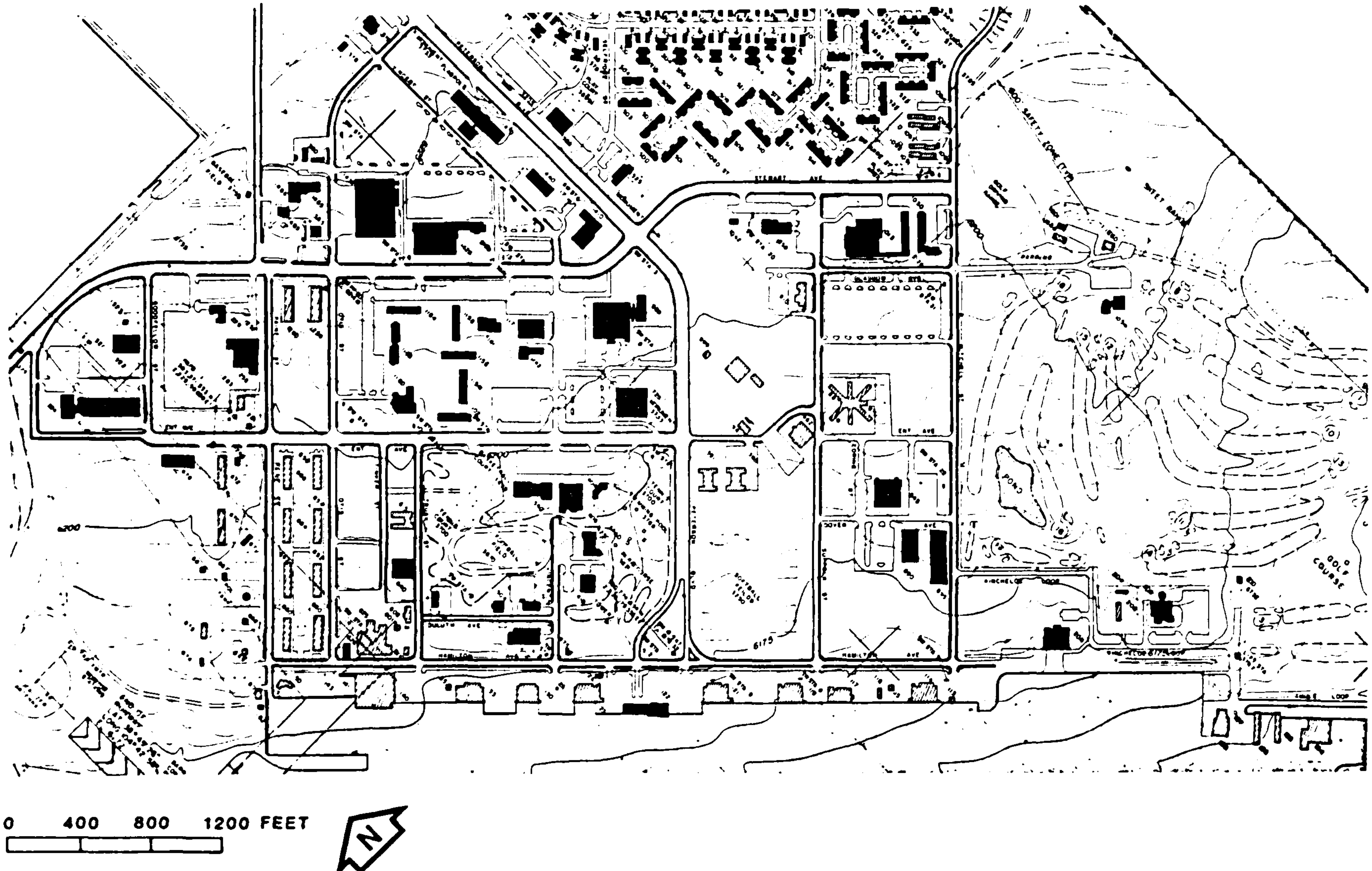
Peterson Air Force Base



SOURCE: PETERSON INSTALLION DOCUMENTS

Figure 2.1-3

OPERATIONS AREA-PAFB

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RESTORATION PROGRAM
Peterson Air Force Base

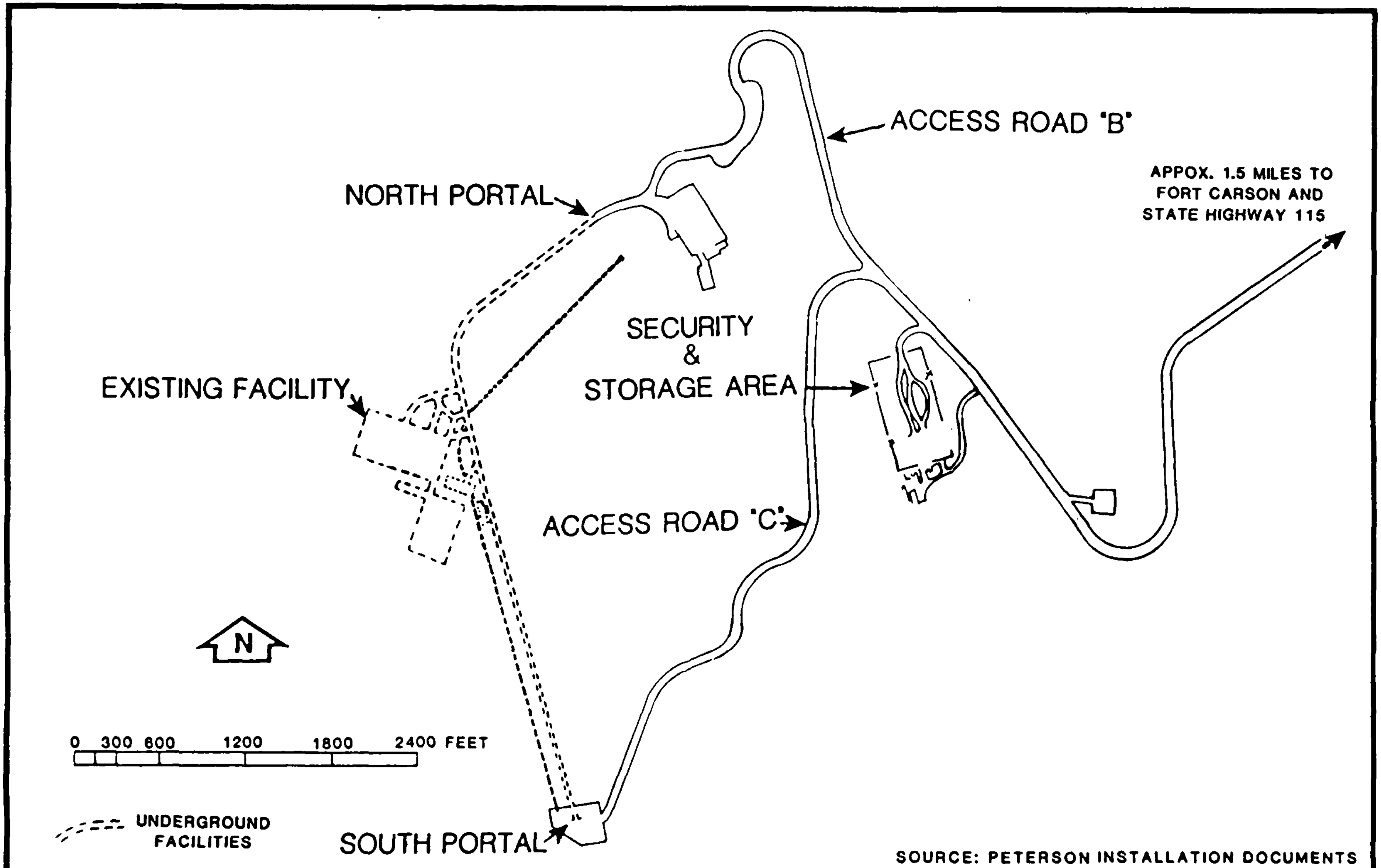


Figure 2.1–4
SITE PLAN–NCMC

INSTALLATION
RESTORATION PROGRAM
Peterson Air Force Base

3rd Air Force took command at Peterson, and the mission changed from photo reconnaissance to bomber training. The 2nd Air Force assumed command of the base in October 1943, and the following month it became Peterson Field, the name still used by many Colorado Springs residents.

In June 1944, the Army began conducting pilot training at the base, which remained Peterson's mission until April 1945 when it became an instructors indoctrination school under the Continental Air Force. Declared surplus after the war, the base was closed in December 1945, and on August 31, 1948, the Federal government returned the property to the city. The municipal airport, which had shared its runway facilities with the Army during the war, continued to operate.

In 1948, the Federal government and Colorado Springs entered into an agreement that guaranteed a flying facility for the 15th Air Force then headquartered at Ent Air Force Base near downtown Colorado Springs, thus reopening the base. When the 15th Air Force moved to California in December 1949, both Ent and the Air Force facilities at Peterson Field were inactivated.

With the subsequent establishment of the Air Defense Command on January 8, 1951, the existing lease for Peterson Field was reactivated, and the 4600th Air Base Group was formed to operate the facility. Steadily increasing operations at Peterson culminated in the elevation of the 4600th to wing status in 1958 and its redesignation as the 46th Aerospace Defense Wing in 1975. By this date the wing had evolved into the single support element for the headquarters of the NORAD and the ADCOM. An earlier decision by the Air Force to close Ent Air Force Base, which also had reopened in 1951, and relocate many of its facilities to Peterson precipitated a building boom at the base beginning in 1974. By 1 March 1976, when Peterson Field became PAFB, many of the facilities now used by the 1st Space Wing had been constructed. Command changes continued when on October 1, 1977 the ADCOM reorganization resulted in the transfer of the 46 AERODW to the 15th Air Force and the Strategic Air Command. The final and most recent changes began on September 1, 1982 with the activation of the Space Command at Peterson. Four months later, on

January 1, 1983, the 1st Space Wing was formed, and on May 1, 1983 SAC transferred control of Peterson to the Space Command and the 1st Space Wing. As the first operational space wing in the Air Force, the Wing has as its mission the management of air base and field sensor units assigned to the Space Command. With the deactivation of the 46 AERODW, the 1st Space Support Group assumed responsibility for base support of Peterson.

NCMC

In June 1959, construction was begun on NORAD's underground facility at Cheyenne Mountain. Formal dedication of the mountain complex was held in 1965. Previously, operations were housed in the five-floor brick Methodist Sanitarium Building in Colorado Springs. An addition to the main building, nearly windowless, steel, and concrete, served as Combat Operations Center (COC), and was the first home of the "Big Board" computer and center of the North American Continent's Aerospace Defense. Today, all of NORAD's worldwide missle, air and space attack warning indicators terminate at the NCMC. Other operations inside the mountain include the Space Defense Operations Center and the National Warning Center. (USAF, 1972; USAF, 1983).

2.3 ORGANIZATION AND MISSION

The facilities of the Peterson Complex are the home of SPACECMD, a new Air Force major command. Established in September 1982, the command is the focal point for space systems passing from the developmental to operational stage. The SPACECMD mission is to manage and operate assigned space assets, to centralize planning, and to consolidate requirements, to provide operational advocacy and to ensure a close interface between research and development activities and operational users of Air Force Space Programs. SPACECMD is also the major air command responsible for the strategic defense missions area. The commander of SPACECMD also serves as Commander-in-Chief of NORAD and Commander-in-Chief of ADCOM.

Organization and mission of the respective installations is as follows:

PAFB

Major Command: Space Command

Subcommand: 1st Space Wing (1SPACEWG)

Mission: To command, administer, train, and evaluate assigned air base and field sensor units (See Figure 2.3-1).

NCMC

Major Command: Space Command

Mission: To provide warning and assessment of ballistic missile attack on the United States or Canada.

2.4 TENANTS

Detachment 4, 1401 Military Airlift Squadron (MAC)

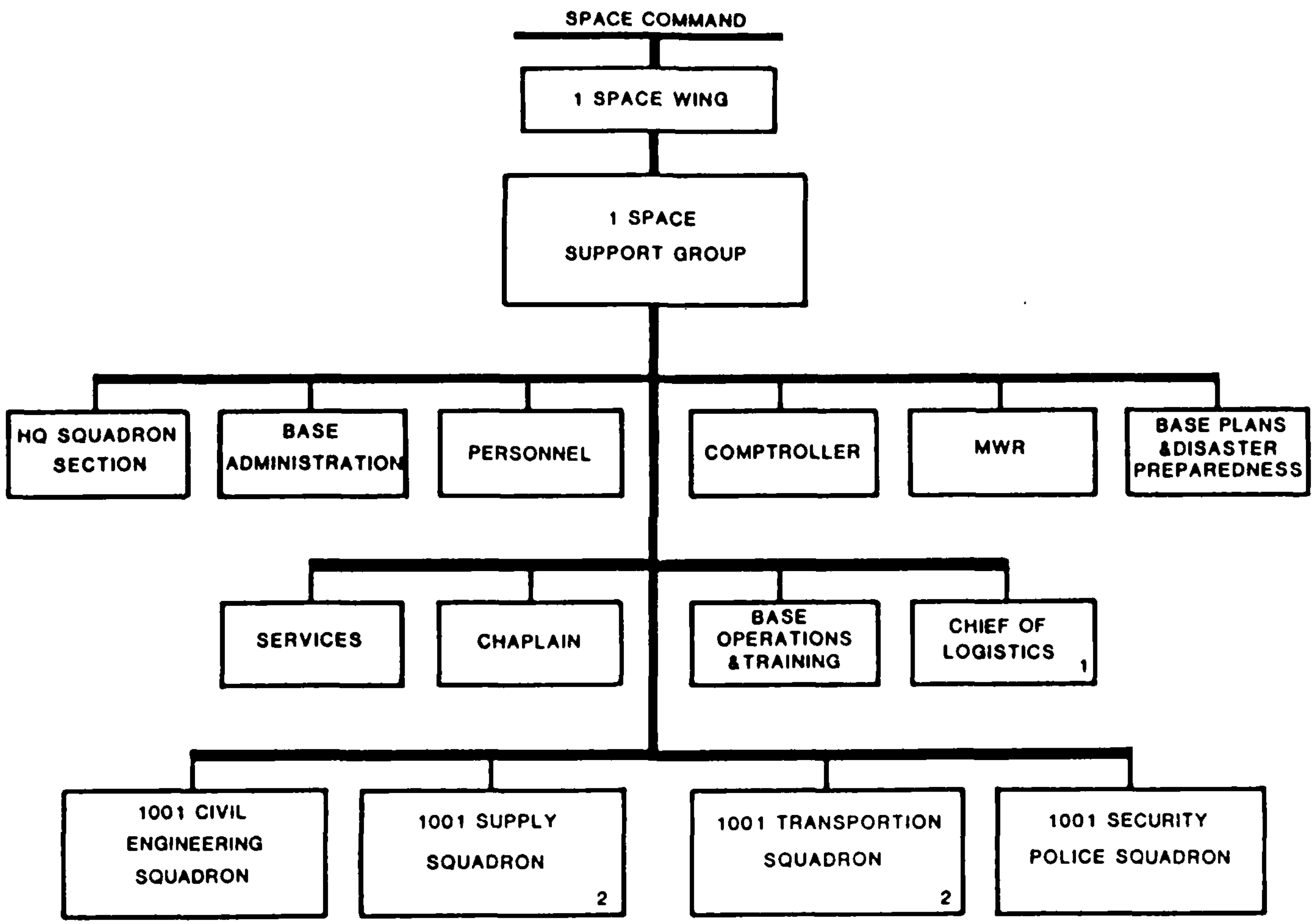
The mission of Det 4, 1401 MAS is to provide Air Force directed operational support airlift during peacetime, contingencies and wartime, including priority movement of personnel and cargo with time, place or mission sensitive requirement.

Red Cross

The Red Cross through the worldwide communication system, helps service members verify emergencies regarding their families. Also helps solve problems pertaining to mail and messages. Counseling in the field of personal and family problems is available to all military personnel and their dependents as well as financial assistance to meet emergency needs. These are just some of the Red Cross services provided to the military. Red Cross reports are obtained on a confidential basis, and the Red Cross serves as a fact finding rather than a recommending agency in those instances when it may be asked to report.

OLJ/CEMIRT

The OLJ/CEMIRT (Civil Engineering Maintenance, Inspection, Repair and Training) Team is a tenant organization of PAFB which functions as a



1. Includes Aircraft Maintenance Branch.
2. Direct reporting units with operational control vested in Chief of logistics.

SOURCE: PETERSON INSTALLATION DOCUMENTS

Figure 2.3-1

ORGANIZATION CHART-1 SPACEWG

INSTALLATION RESTORATION PROGRAM
Peterson Air Force Base

depot level source of maintenance, repair and storage of USAF equipment in fields of Power Production (diesel generators), Electrical Distribution, (Interior/Exterior), and Heating, Ventilating, Air Conditioning. This team's area of direct responsibility is 12 states located in the Central Region of the United States.

Detachment 6, 9th Weather Squadron

The mission of Detachment 6, 9th Weather Squadron is providing weather support to military agencies located on PAFB on a twenty-four hour per day basis. This includes flight weather briefings, terminal forecasts, weather warnings, and meteorological watch of weather parameters. Detachment 6, 9th Weather Squadron also provides all weather support required by the USAF Academy and Base when forecasters are not on duty. The Detachment Chief is also responsible for providing weather staff support to both the Air Academy and PAFB.

Air Force Commissary Service

Mission of the Rocky Mountain Complex: Responsible for accomplishing the AFCOMS mission by providing operational supervision over Air Force Commissaries at Lowry, Peterson, F.E. Warren Air Force Bases, and the USAF Academy. This responsibility is met by providing the above stores technical advice, assistance, and direction through staff assistance, inspection and compliance visits. Additional support is provided the above stores by preparing and administering O&M, Stock Fund and Surcharge Budgets to provide required funding for employee salaries, TDY, purpose of food to be issued and sold, and acquisition of equipment, supplies and other authorized costs associated with operation of modern supermarket type activities. In addition to the resale stores, they are responsible for the troop subsistence at the above cited installation which includes providing War Readiness Materials (WRM) requirements and providing rations to numerous National Guard and Reserve activities station in or coming to the Colorado-Wyoming area for training and/or excerises.

Federal Aviation Administration

Colorado Springs Airport Traffic Control Tower (ATCT). Provides safe, orderly and expeditious air traffic service to VFR and IFR air carrier, general aviation and military aircraft operating into, out of, or through, the Colorado Springs delegated airspace. Annual operations total 135,000.

Colorado Springs Airway Facilities Section (AFS). To maintain and operate all National Airspace System facilities within the sector, assuring that performance is within established tolerances of accuracy and meets operational requirements of availability and reliability; to maintain environmental support facilities and equipment; and to effectively manage available resources.

USAF Judiciary Area Defense Counsel

The Area Defense Counsel office is staffed with a military attorney and an Area Defense Administrator to assist active duty military members who are subject to various criminal and administrative actions.

901 Tactical Airlift Group (AFRES)

The Air Force Reserve Tactical Airlift Unit mission is to attain that level of operations readiness which will enable the unit to effectively: airlift troops, supplies and equipment into prepared or unprepared landing areas either by parachute or by air landing and to continuously supply such forces until they are withdrawn or are supplied by other means; accomplish medium range airlift of supplies, personnel and equipment for the combat force in the front lines, or elsewhere within the theater of operation, as directed by the theater commander; perform aeromedical evacuation of personnel; and perform all assigned duties during the hours of daylight and darkness under all weather conditions.

OL-PN Space Combat Operations Staff

SPACECMDMET operates at base level to service as representatives of the Space Command Manpower and Orgainzation staff. The team provides onsite evaluation, manpower services, and organizational services to base units.

Detachment 1, 4700 ADS (TAC)

The mission of DEW System is to provide field activities in support of the Deputy Commander for Air Defense, HQ TAC, to include: Distant Early Warning (DEW) System Office, Logistics Readiness Center, CE Site Development Team, Chaplain Auxiliary and Medical Augmentation.

Detachment 1, 557 FTS (ATC)

The mission of Det 1, 557 FTS is to provide airlift support for the USAF Academy cadet parachute training program and for the "Wings of Blue" demonstration team.

Detachment 1401, Air Force Office Special Investigations

AFOSI Det 1401 conducts investigations involving major crimes, fraud matters, and counter intelligence investigations in accordance with AFR 23-18 or directed by higher authority. This detachment provides this investigative support to all USAF units located throughout southern Colorado below a line drawn through Castle Rock, except the USAF Academy.

Air Force Special Staff MGT Engineering Team (AFSSMET)

The AFSSMET has the mission of developing and maintaining Manpower Standards Air Force-wide in such functions as legal, command, chaplain, history, inspection, information, safety and administration. In addition, the AFSSMET provides management consultant services to functional managers at all levels of command.

Air Force Audit Agency (AFAA)

The mission of the AFAA is to provide all levels of Air Force management with independent, objective, and constructive evaluations of the economy, effectiveness, and efficiency with which managerial responsiblities are carried out. This office performs audits at PAFB, NCMC, Chidlaw Building, and the USAF Academy.

Detachment 2, 339th SS (ATC)

The mission of Detachment 2, 3391st SS is to provide onsite formal technical instruction necessary to qualify personnel in the skills,

knowledge, and techniques required to operate, maintain, and program the computers and related equipment located on the PAFB Complex. Additionally, Detachment 2 is responsible to provide training to locally assigned space systems operation personnel and to those going to sites all over the world.

2163rd Communications Squadron

The 2163rd Communications Squadron provides communications support to PAFB, the Chidlaw Building, and some agencies in Cheyenne Mountain. This includes telecommunications, telephone service, public address support, maintenance of radio and weather equipment, and intrabase radio operations.

Colorado ANG, 139 Tactical Control Flight (TCF)

The mission of 139TCF is to provide radar surveillance and control within its assigned area of responsibility. Controls aircraft, both offensive and defensive, and provides a radar advisory service with seven weapons control/surveillance consoles. Has air-to-ground and point-to-point communications.

3.0 ENVIRONMENTAL SETTING

3.1 METEOROLOGY

The climate of PAFB, as derived from recorded data for the City of Colorado Springs is classified as mid-latitude, semi-arid and characterized by hot summers, cold winters, and relatively light rainfall.

The mean maximum temperature in the area is 43.5 degrees Farenheit (°F) in January and 88.2 °F in July. The mean minimum temperatures are 14.9 °F in January and 57.2 °F in July. Recorded extremes were 100.0 °F in July 1954 and -27.0 °F in February 1951. Monthly mean maximums, minimums, and averages are shown on Table 3.1-1.

The prevailing wind direction at PAFB is from the north, with monthly average speeds of 9.3 miles per hour (mph) to 12.1 mph. Speeds of 68 mph or more have returned period of 10 years, and generally occur in the fall, winter, and spring due to west-to-east chinook winds. Monthly average wind speeds are shown in Table 3.1-1.

Precipitation in the area varies with specific locations due to elevation and terrain differences. Annual averages are 12 to 15 inches per year (in/yr), with approximately 80 percent falling between April and September. Average annual snowfall in the region is 36.2 in/yr. Snow and sleet usually occur from September to May, with the heaviest snowfall in March and possible trace accumulations as late as June.

3.2 GEOGRAPHY

3.2.1 PHYSIOGRAPHY

PAFB is in the Colorado Piedmont section of the Great Plains Physiographic Province. Elevations on the base range from 6,000 feet (ft) to 6,300 ft, with a surface slope generally to the southwest.

The three major land forms in the Colorado Springs area are low plains, high plains, and low hills. Southwest of PAFB, the area is characterized by low plains dissected by tributaries to Fountain Creek. PAFB itself

Table 3.1-1. Climatological Data for PAFB (1949 - 1978)

Month	Temperature (°F)			Precipitation (in)			Wind Speed (mph)
	Mean Daily Maximum	Mean Daily Minimum	Monthly Mean	Minimum	Mean	Maximum	
January	43.7	49.1	34.7	0.02	0.30	1.28	9.7
February	46.8	45.3	32.1	0.01	0.40	0.76	10.3
March	52.3	39.9	38.1	0.03	0.61	1.56	11.4
April	62.2	34.0	48.2	T	1.14	6.06	12.1
May	71.8	43.7	57.7	0.31	1.94	5.55	11.4
June	82.8	53.2	67.8	0.11	1.69	6.13	10.8
July	88.2	58.8	73.4	0.59	2.47	4.83	9.5
August	86.4	57.6	72.0	0.35	2.07	5.89	9.2
September	79.3	48.9	64.2	T	1.14	3.50	9.5
October	67.8	37.2	52.5	T	0.91	3.88	9.7
November	53.4	39.9	38.8	T	0.50	2.32	9.7
December	46.8	45.7	32.5	T	0.28	0.96	9.7

Legend:
°F = degrees Farenheit
in = inches
mph = miles per hour
T = trace

lies in an area dominated by gently to strongly rolling high plains. The area west and north of PAFB is dominated by the low hills, which are characterized by rounded to sharp-crested hills, rocky surfaces, with occasional gently rolling uplands and shallow canyons with nearly vertical walls.

3.2.2 SURFACE HYDROLOGY

PAFB lies within the Arkansas River Basin. Fountain Creek, a perennial stream originating 7 miles northwest of Pikes Peak, flows southeast through Colorado Springs west of PAFB and joins the Arkansas River in the vicinity of Pueblo. This creek and its tributaries provide surface drainage within PAFB. Monument Creek is the only perennial stream tributary to Fountain Creek; PAFB's intermittent tributaries include Sand Creek, Young Hollow Creek, and Little Fountain Creek. The channel of East Fork Sand Creek is the largest surface drainage feature on PAFB, crossing the northwest corner of the base.

Drainage from the developed areas of the base is captured in gutter inlets and flows through underground pipes to one of several outfalls. The airfield drains through surface ditches. The majority of the developed area and the flightline drains to the golf course pond and is subsequently used for irrigation. The northwest corner of the base drains into East Fork Sand Creek. Remaining airfield areas drain through unnamed intermittent channels tributary to Fountain Creek. Drainage areas are illustrated in Figure 3.2-1.

Drainage from NCMC flows generally eastward through several intermittant drainage channels within the Fountain Creek basin. Most of the facility is underground, and drainage from these areas includes natural seepage and cooling water. It is discharged through an oil water seperator into a small natural channel which flows eastward approximately 5 miles to a confluence with Fountain Creek. Drainage patterns are illustrated in Figure 3.2-2.

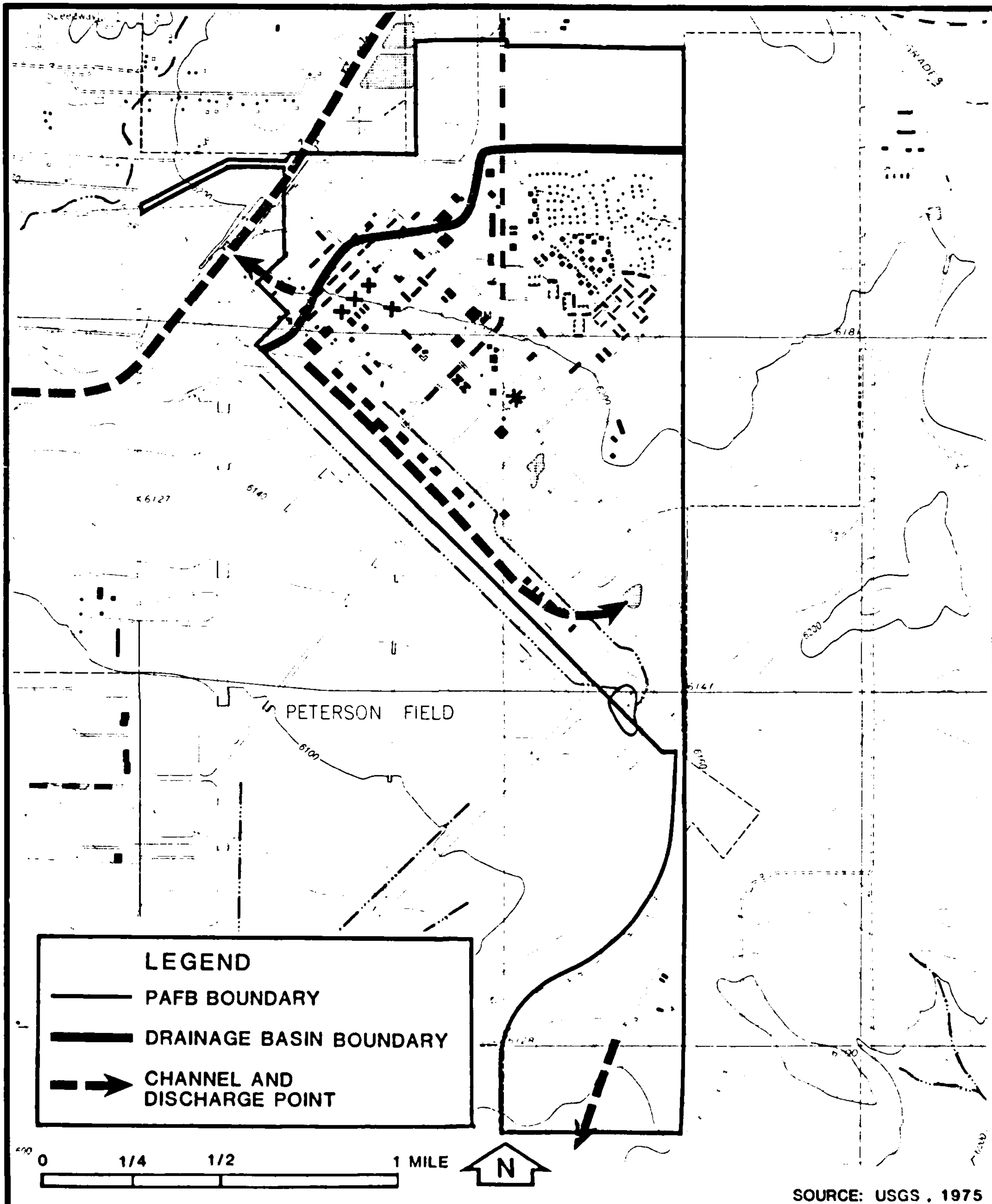


Figure 3.2-1
SURFACE WATER DRAINAGE

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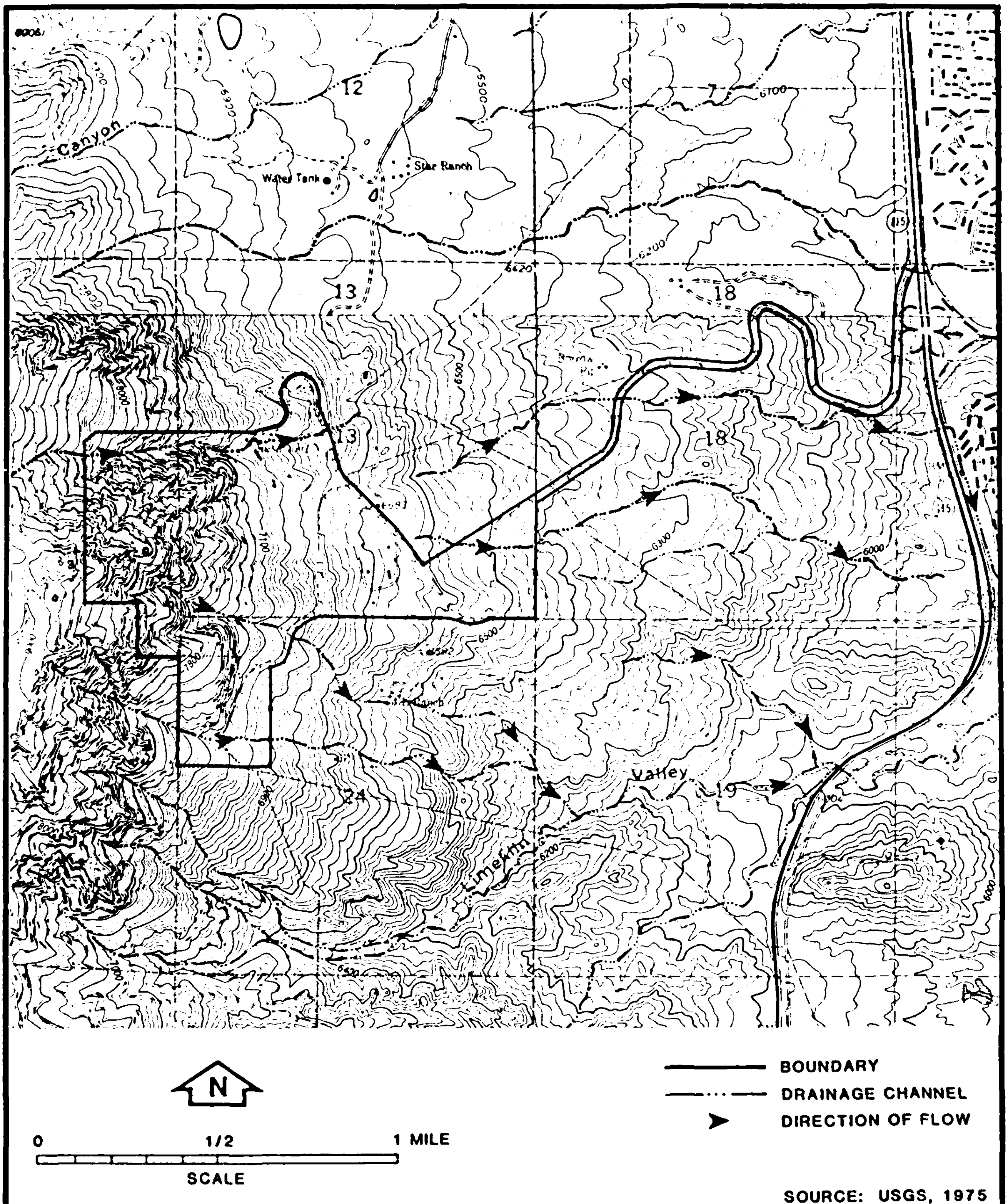

Figure 3.2-2
SURFACE WATER DRAINAGE - NCMC

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Peterson Air Force Base

3.3 GEOLOGY

3.3.1 GEOLOGIC SETTING

Geologic History

PAFB is located on the southwestern edge of the Denver Basin (Figure 3.3-1). This Basin is an asymmetric structural depression with a gentle eastern and a steep western flank. The basin axis trends north-south, nearly paralleling the Front Range. Over 13,000 ft of Phanerozoic strata are contained by the basin which covers 60,000 square miles of Colorado, Wyoming, Kansas, and Nebraska (Martin, 1965). Structural relief on the top of the Precambrian varies between the deepest part of the basin, and the bounding uplifts. The Front and Laramie Ranges to the west (21,000 ft); The Hartville Uplift to the northwest (11,900 ft); The Black Hills and Chadron-Cambridge Arch to the northeast (7,000 ft); The Las Animas Arch to the southeast (6,900 ft); and The Sierra Grande and Apishapa Uplifts to the southwest (8,000 ft).

The tectonic history of the area preserved in the rock record spans 1.8 billion years, and may be divided into four major phases: 1) Precambrian diastrophism affecting the crystalline basement; 2) Early Paleozoic epeirogenic movements near sea level, culminated by the Ancestral Rockies orogeny; 3) Mesozoic epeirogenic movements and Late Cretaceous to Miocene Laramide Deformation; and 4) Post Laramide uplift and basin filling.

The tectonic framework of the area was established in the Precambrian and most of the structural features were strongly influenced by this initial framework (Badgley, 1960). About two-thirds of the tectonic history of the area took place within the Precambrian Era, when events were probably more frequent and intense than in the succeeding Phanerozoic. Precambrian history is difficult to reconstruct due to subsequent tectonism and metamorphism (RMAG, 1972). The specific events which are relevant to Phanerozoic tectonics and sedimentation were: 1) The initiation of major fault and shear zone systems; and 2) The formation of the Transcontinental Arch. Recurrent motion within these systems during several Phanerozoic episodes has documentedly affected sediment distributions.

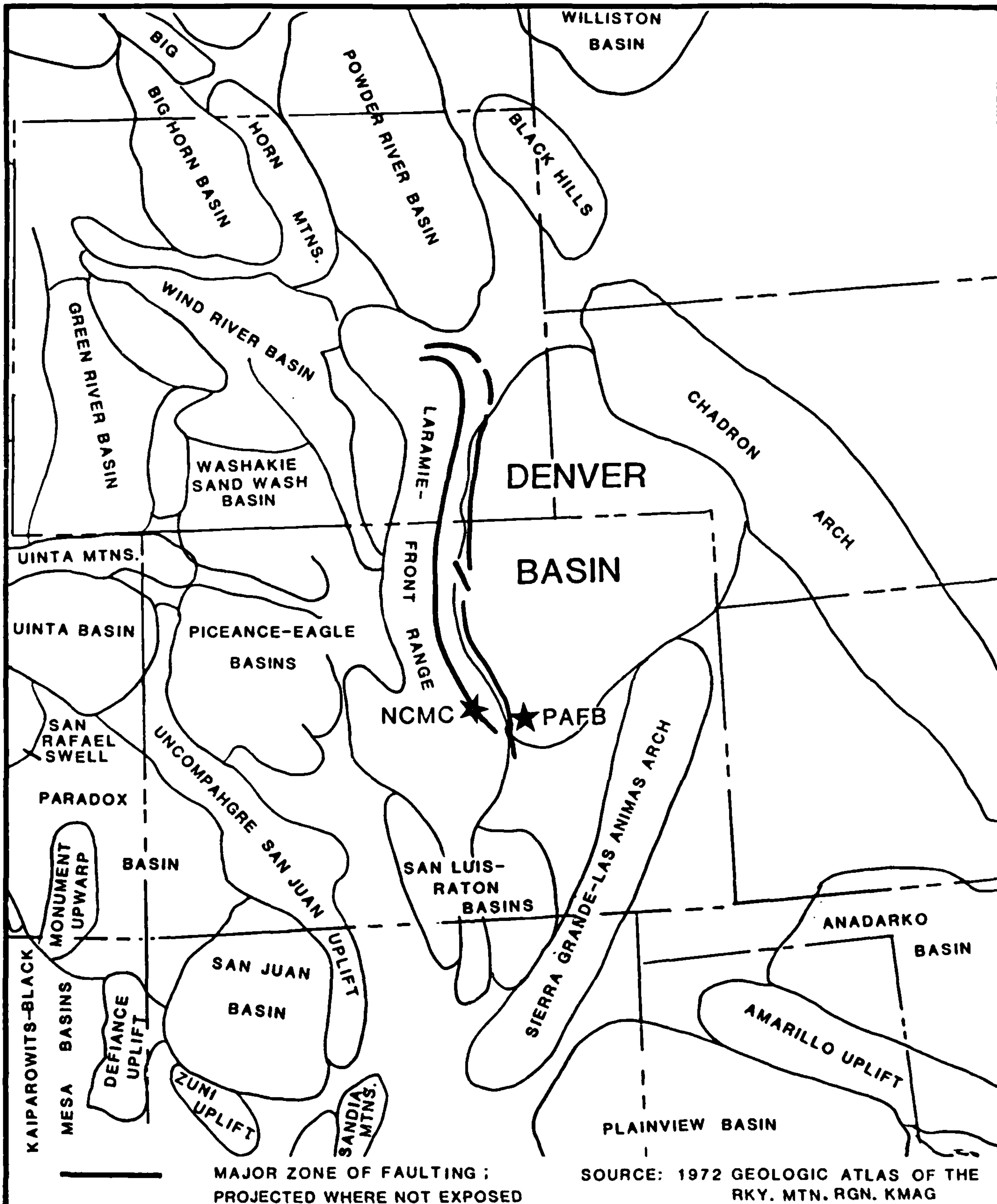

Figure 3.3-1 MAJOR STRUCTURAL ELEMENTS	INSTALLATION RESTORATION PROGRAM Peterson Air Force Base

Throughout the Early Paleozoic, the Front Range manifested a tendency towards structural stability. Regional movements were broad and gentle uplifts or downwarps (Harms, 1964). Cambrian and Ordivician Seas advanced across Colorado from the east and the west, continuously inundating the central portion of the state (Berg, 1965). Three major tectonic elements effected distribution patterns during this period as well as through the Mississippian. The positive areas of Siouxa and Sierra Grande respectively to the north and south, separated by the east-west trending Colorado Sag. The sea slowly transgressed over the Sierra Grande positive area in south-central Colorado. Later Ordivician deposition was characterized by alternate periods of submergence and uplift.

Pre-Mississippian erosion removed virtually all Silurian to Mid-Devonian strata which may have been deposited in the basin. In fact, Cambro-Ordivician rocks have been removed from all but the southern part of the Denver Basin.

During the Late Devonian, the sea spread eastward from the Cordilleran Trough to cover most of Western Colorado. The transgressing sea reworked the weathered Silurian and Mid-Devonian terrain (Rothrock, 1965).

Early Mississippian was a period of relatively quiesent, shallow marine carbonate deposition in a predominantly regressive sequence, subarealy exposing the area by Late Mississippian time.

Late Mississippian-Early Pennsylvanian deformation and folding marked a change in crustal behavior, manifested by uplift of the Ancestral Rockies. Harms (1964) maintains that the paleozoic uplift was "tectonically speaking, a relatively mild feature bordered by narrow fault zones or monoclines. Like later Laramide features, these mountains probably reflect vertical uplift of a crustal block. It was during this uplift that continental sediments appeared for the first time. (South and southwestern parts of the basin). The Ancestral Rockies continued to develop until Mid-Permian. Tectonic stability had apparently returned to

this area by the end of Paleozoic time. Bevelling and burial of earlier uplift of the ancestral rockies was slowly accomplished.

Lower Mesozoic (Triassic) rocks were deposited on a moderately stable shelf, sloping westward toward a geosyncline whose eastern flank lay in western Utah. Regional uplift recurred by Mid-Triassic time. Uplift occured across southern Colorado which resulted in regional truncation of Permian and Lower Triassic strata. The Canon City area, west of Colorado Springs was near the center of this Mid-Triassic upwarping.

During Late Cretaceous, the movement was reversed. The southern Front Range area became involved in subsidence on a regional scale. In latest Cretaceous time, an orogenic era of profound significance, called the Laramide was initiated. It was during this burst of Laramide tectonism that the Denver Basin acquired its present configuration. The Front Range of Colorado was formed by Laramide deformation. Although the Laramide ended in the miocene (Harms, 1964), deformation of the southern Front Range continued into post-Laramide time (Oligiocene and Holocene). Activity in the region consisted of epeirogenic uplift and localized Basin and Range faulting.

The stratigraphic record for much of the Tertiary is poor, but interpretation of the existing rock record indicates that mild upwarping occured during the late Tertiary. This movement probably continued into the Pleistocene.

Regional Geology-Structural and Stratigraphic Summary

PAFB lies just east of the southern Front Range Piedmont, on the steeply dipping western limb of the Denver Basin (Figure 3.3-2 through 3.3-4). The flanks of the Front Range are formed by faults with large vertical displacements or by steep monoclinal folds. PAFB is located approximately 8.5 miles east of a reverse fault called the Ute Mountain Pass Fault. This feature describes an accurate eastern boundary of the part of Pikes Peak Batholith called Cheyenne Mountain.

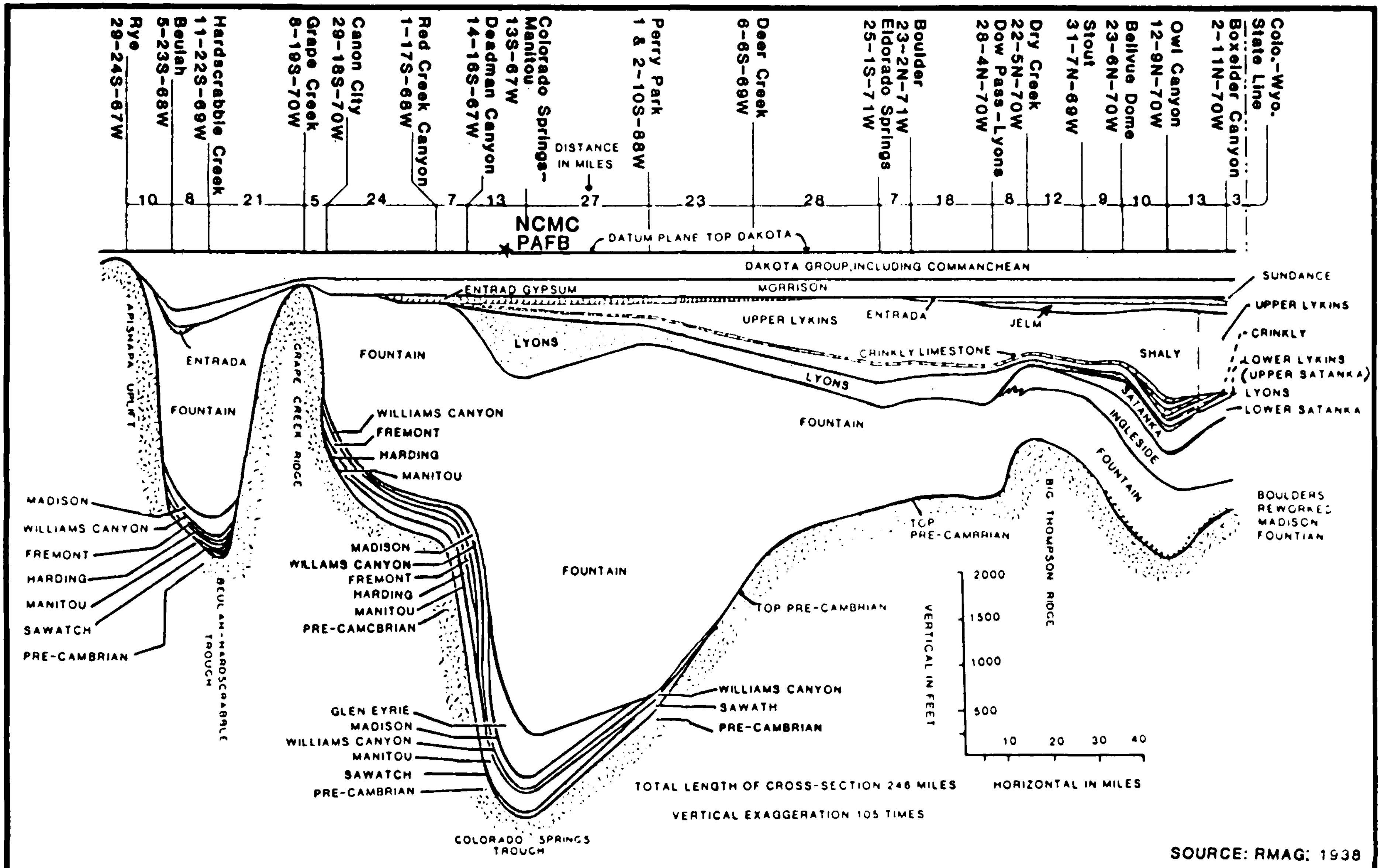

Figure 3.3-2
GEOLOGIC CROSS SECTION

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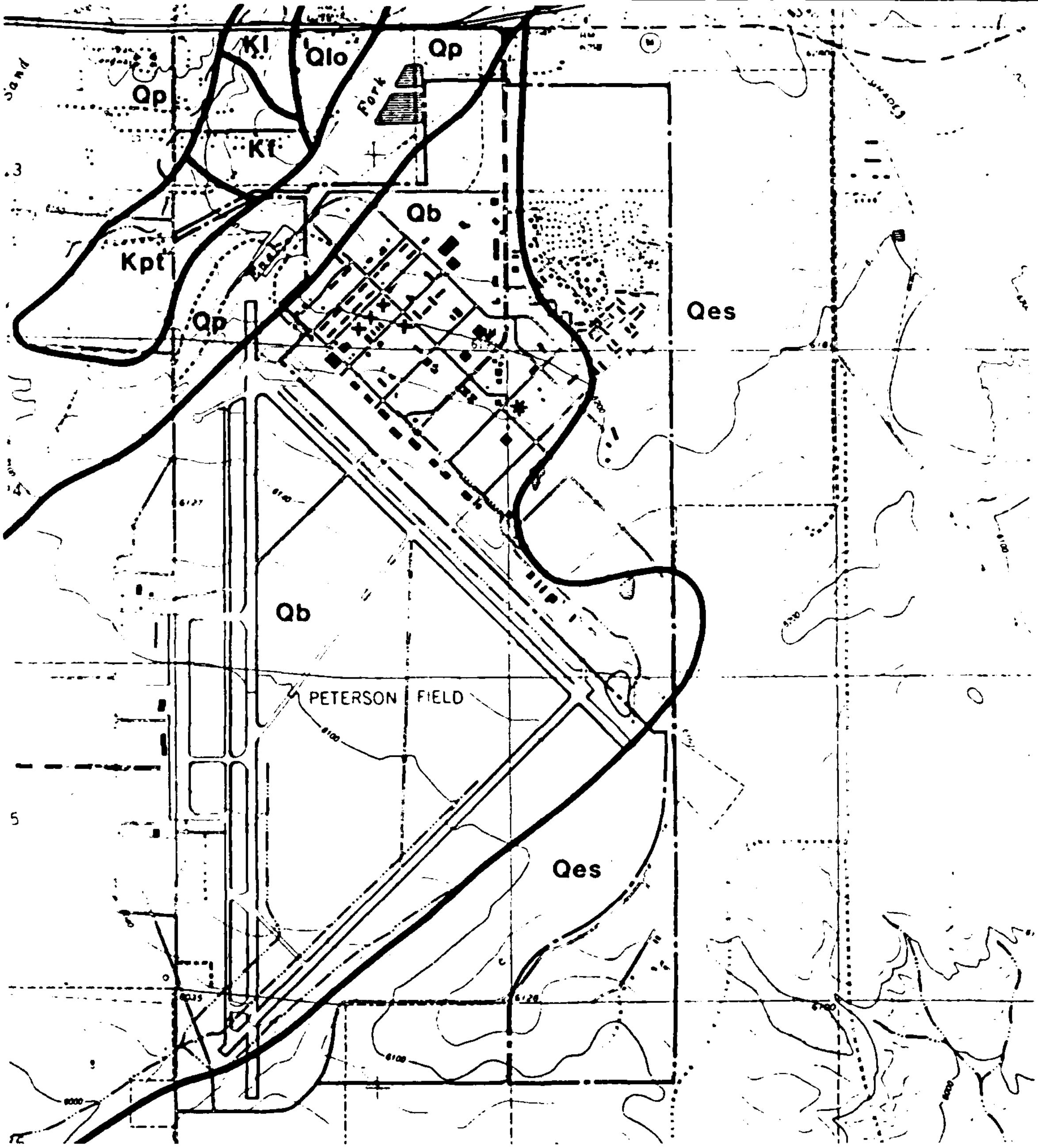

EXPLANATION

Qp	PINEY CREEK ALLUVIUM
Qes	EOLIAN SAND
Qb	BROADWAY ALLUVIUM
Qs	SLOCUM ALLUVIUM
Kl	LARMIE FORMATION
Kf	FOX HILLS SANDSTONE
Kpt	PIERRE SHALE

0 1/4 1/2 1 MILE

N

—·— INSTALLATION BOUNDARY

SOURCE: G.R. Scott & R.A. Wobus, 1973

Figure 3.3-3
SURFACE GEOLOGY

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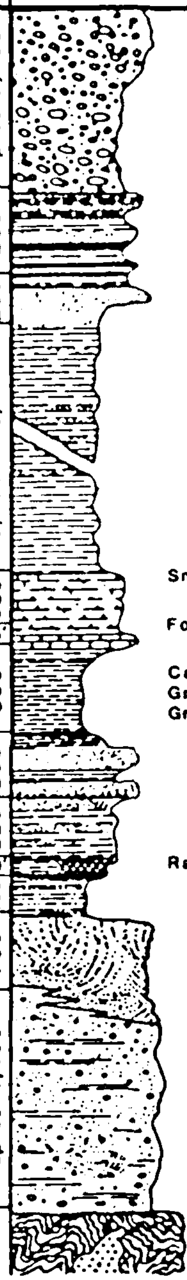


Era	System or Series	Formation	Thk.	Summary Description
CENOZOIC	LOWER TERTIARY	DAWSON ARKOSE	up to 2,000'	[UNCONFORMITY] Contains arkosic & andesitic (minor) units, in part occuring in separate beds.
MESOZOIC	UPPER CRETACEOUS	LARAMIE	250'	Grayish yellow fine grained, iron stained sandstone, olive gray claystone & subbituminous coal beds.
		FOX HILLS	250'	Lt. gray, thin bedded, friable, sandy shale in upper 100 feet. Massive, fine-grained sandstone in lower 150 feet.
		PIERRE	3,750' - 5,200'	Marine shale containing bentonite beds & fossils.
		NIOBRARA	530'	Smokey Hill member: Shale calcareous, with thin beds of limestone.
			35'	Fort Hays member: Limestone beds, separated by shale partings.
			300'	Carlile: Shale. Green Horn: Limestone. Graneros: Shale.
	LOWER CRETACEOUS	DAKOTA	250'	*Fine grained cross-bedded* sandstone, containing some shale in upper, middle parts.
	JURRASSIC	MORRISON	225'	Siltstone & claystone, containing few thin lt. gray, dense limestone & sandstone.
		RALSTON CK	20'	Ralston Ck.: Sandstone, siltstone, gypsum, lime w/jasper.
PALEOZOIC	PERMIAN	LYKINS	180'	Maroon & green silty shale with limestone & gypsum beds.
		LYONS	750'	Fine grained sandstone w/ local conglomerate.
	PENNSYLVANIAN	FOUNTAIN	up to 4,400'	Reddish-brown arkosic conglomerate & coarse grained arkosic sandstone.
PRECAMBRIAN				Banded gneiss intruded by granite masses & pegmatites.

SOURCE: Haun, 1960

Figure 3.3-4
STRATIGRAPHIC COLUMN
(Page 1 of 2)

INSTALLATION RESTORATION PROGRAM
Peterson Air Force Base

ERA	SYSTEM OR SERIES	EPOCH	FORMATION OR DEPOSIT
CENOZOIC	QUATERNARY	HOLOCENE	artificial fill Post-Piney Creek alluvium eolian sand/loess Piney Creek alluvium
			(soil) Pre-Piney Creek alluvium eolian sand/loess
		PLEISTOCENE	Broadway alluvium loess
			(soil) Slocum alluvium
			(soil) xxx(ash)xxx Verdos alluvium
			(soil) Rocky Flats alluvium

(UNCONFORMITY)

SOURCE: J. E. Costa and S. W. Bilodeau

Figure 3.3-4

STRATIGRAPHIC COLUMN
(Page 2 of 2)

INSTALLATION RESTORATION PROGRAM
Peterson Air Force Base

The change in elevation of the Precambrian rocks takes place in a relatively narrow belt. The Denver Basin does not exhibit structural features of significant size. Precambrian strata consist of metamorphic and igneous components in the Colorado Springs area as most of Colorado did not receive any Precambrian sediments (Curtis, 1960).

During the Cambrian and Early Ordivician, a shallow epicontinental sea transgressed onto Colorado in a southeast direction. In eastern Colorado, the sea was also encroaching towards the west. This marine invasion finally reached central Colorado by Upper Cambrian time and deposited the clastic Sawatch Formation, conformably overlain by the Early Ordivician Ute Pass Carbonates.

Where found, Mid- and Upper-Ordivician strata unconformably overlie Lower Ordivician and Precambrian sediments. This unconformity resulted from a withdrawl of the sea to the Cordilleran Geosyncline. The sea began a second cycle of sedimentation when it again transgressed the area depositing the Harding and Freemont formations in clear marine waters. Another period of pre-devonian uplift and erosion subsequently removed these rocks from much of the state (Haun, and Kent, 1965). While not present underneath PAFB, outcrops may be found just east near the Canon City area (McKee, 1957).

The Silurian record is the most fragmentary part of regional stratigraphic history. It is likely that deposition of strata was continuous from Late Ordivician time through Silurian time, but obliteration of the rock record occured during the Pre-Devonian erosion, and again during a Pre-Mississippian event (Mallory, 1965). Thus, there is no representation of the Silurian in the Colorado Springs region.

The sea withdrew from the craton during Early Devonian. It was during this period of uplift and extensive erosion that the Mid-Devonian through Silurian rocks were removed. The northeast-trending Transcontinental Arch was a major positive feature, influencing sedimentation patterns. Williams Canyon Formation represents a thin layer of sediments deposited

in shallow water when the sea transgressed the shelf eastward from the Cordilleran trough in Late Devonian to Mississippian time.

The total Mississippian picture is one of continued transgression and completion of the sedimentary cycle which began in Devonian time. The Hardscrabble and Beulah Carbonates were deposited across the shelf. There was some uplift in parts of the Front Range in the Early Mississippian. Later Mississippian strata thus unconformably overlie Early Mississippian rocks.

Pennsylvanian sedimentary patterns contrast markedly with the patterns of previous Paleozoic sediments (Maughan & Wilson, 1960). The event called the Ancestral Rocky Uplift occurred, resulting in the Pre-Pennsylvanian unconformity. Coarse arkosic wedges of sediment were shed off the uplift, resulting in the famous Fountain Formation (Garden of the Gods). By Late Pennsylvanian time, four new geologic developments took place in Colorado: 1) a change in character from basin subsidence to shelf subsidence: 2) deposition of large volumes of fine-grained sediments; 3) areal extension of red bed distribution; and 4) development of well-sorted sandstones in association with the red beds.

The Ancestral Rocky Mountain Uplift lost momentum during Permian time with the mountains continuing to shed variable amounts of arkosic conglomeratic sediments into the Denver Basin. The Lyons Sandstone and the Lykins Carbonates were deposited as part of the Permian transgressive cycle.

Triassic sediments formed an eastwardly thinning wedge deposited on a moderately stable shelf sloping west towards the Cordilleran Geosyncline (Oriel and Craig, 1960). Central Colorado was a positive feature during this time and thus the Triassic is not represented in the Colorado Springs area. (Lykins Formation is considered Permo-Triassic, and is designated Permian in this study.)

A shift occurred in the Jurrassic with respect to source direction. The seas invaded from the artic during Late Jurrassic and Cretaceous time.

Local tectonic instability in the Late Jurassic resulted in coarse detritus deposited near the Wet Mountain Uplift, south of Colorado Springs. Positive elements were bevelled flat by the close of the Jurassic Period by Fluvial processes.

The Lower Cretaceous witnessed an extensive invasion of the Cretaceous Seas from the Artic and from the Gulf, resulting in ajoining of the two bodies of water to form the Cretaceous Seaway. Eventually, the west became a dominant sourceland from which thick clastics were shed (Niobrara, Pierre Shale, Fox Hills). The Cretaceous Sea regressed west to east, periodically interrupted by transgressions. The PAFB rests on the Cretaceous Foxhills sand stone which represents the last marine sandstone deposited in this region. In latest Cretaceous time, sedimentary patterns were significantly changed by the initiation of the most important tectonic event since Pre-Paleozoic. This event was the Laramide Orogeny which was characterized by vertical uplifts, compressive folds and faults, thick continental deposits (Upper Laramie, Denver Formation), and volcanism (Haun and Weiner, 1960).

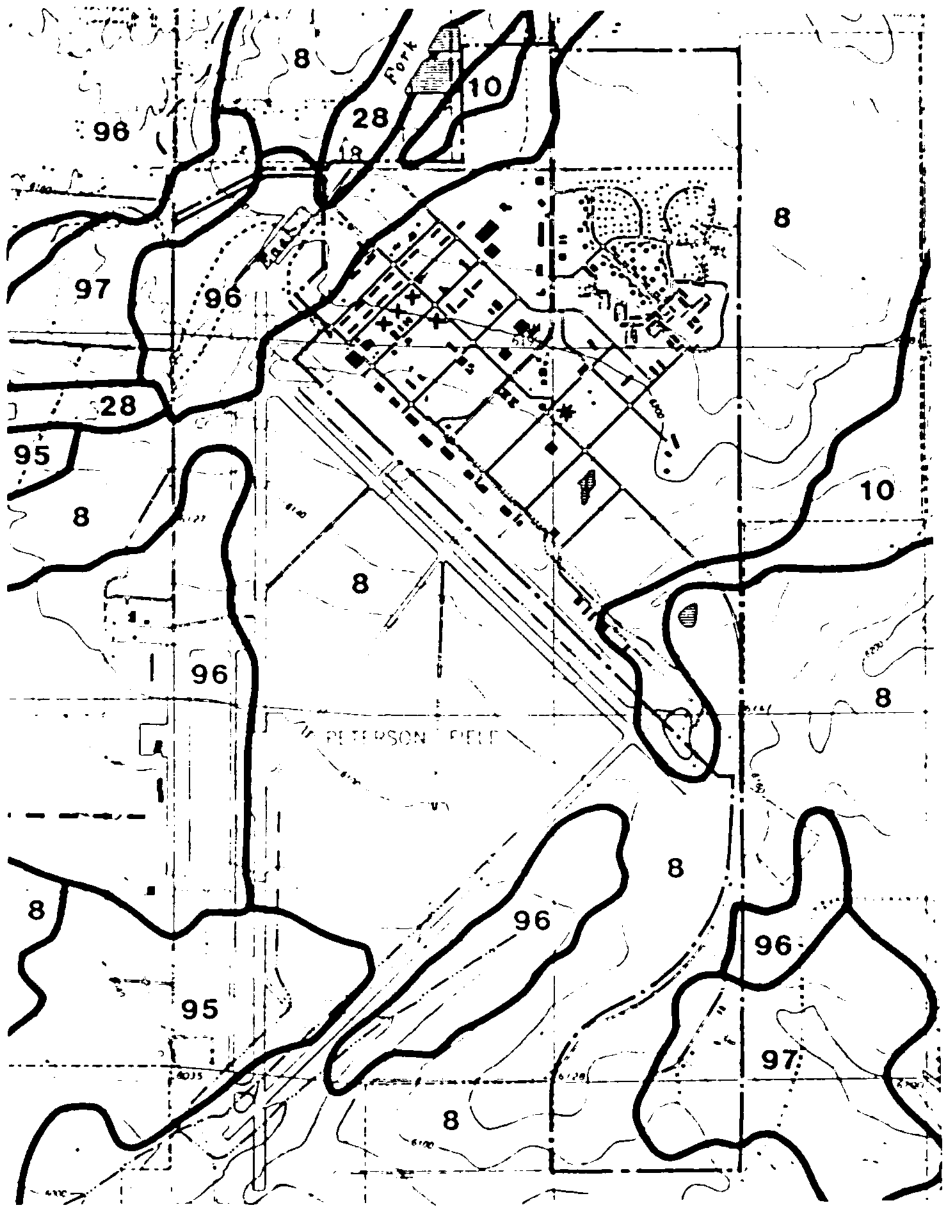
The Late Tertiary saw the establishment of present drainage patterns and geomorphic features, basin filling, and volcanism. The Dawson and the overlying arkose were deposited during this period.

3.3.2 SOILS

Soil is considered to be the most important natural resource in the PAFB area. These soils are resting on fans, terraces, and sideslopes of the semi-arid foothills and plains flanking the Front Range (Figure 3.3-5). All four series of soils located on PAFB may be generally characterized as sandy soils originating from the weathering of arkosic sedimentary units, having neutral pHs, and high permeability (Larsen, 1975).

<u>Blakeland</u>

Derived from arkosic sandy alluvium, and eolian sediments in the uplands, this series consists of deep, somewhat excessively drained loamy sands. A typical pedon of Blakeland loamy sand may be divided into three units: 1) Surface layer slightly acidic, dark grayish-brown loamy sand



EXPLANATION

8	Blakeland sandy loam
10	Blendon sandy loam
11	Bresser sandy loam
28	Ellicott loamy coarse sand
95	Truckton loamy sand
96	Truckton sandy loam
97	Truckton sandy loam

0 1/4 1/2 1 MILE

N

INSTALLATION BOUNDARY

SOURCE: U.S. DOA, (SCS) 1981

Figure 3.3-5
SOIL TYPES

INSTALLATION RESTORATION PROGRAM
Peterson Air Force Base

(0-11 in); 2) Substratum: neutral pH, brown loamy sand (11-27 in); and 3) grading into neutral pH pale brown sand (27-60 in). The permeability of Blakeland is rapid.

Blendon

The Blendon series consists of deep, well-drained sandy loams formed in sandy arkosic alluvium, on alluvial fans and terraces. This series is typically divided into three zones: 1) Surface: slightly acidic grayish brown sandy loam (0-10 in); 2) Subsoil: neutral pH, brown sandy clay loam (10-36 in); and 3) Substratum: neutral pH, light yellowish brown loamy coarse sand (36-60 in). Permeability of this series is moderately rapid.

Ellicott

The Ellicott series is a deep, somewhat excessively drained loamy coarse sand, found on terraces and flood plains. Surface layer: neutral pH, grayish brown loamy coarse sand (0-7 in), underlying material: neutral pH, light brownish gray coarse sand which is stratified with layers of loamy sand, loamy coarse sand, and coarse sandy loam. Permeability of the Ellicott is rapid.

Tructon

The Tructon series is made up or loamy sands and sandy loams which are deep, and well drained. They were formed in alluvium and residum derived from arkosic sedimentary rock on uplands. There are three generalized units: 1) Surface layer: neutral pH, brown loamy sand or sandy loam (0-8 in); 2) Subsoil: neutral, brown sandy loam (3-18 in); and 3) Substratum: neutral pH, light yellowish brown, coarse sandy loam (24-60 in). Permeability of this series is moderately rapid.

3.3.3 GEOHYDROLOGY

PAFB is situated on the southwestern flank of the Denver Basin, overlying steeply dipping Cretaceous bedrock. Quaternary Alluvium blankets the northeastern dipping bedrock with coarse, sandy sediments up to 50 ft thick. The primary aquifers underlying the base are Quaternary alluvium and the underlying Laramie-Foxhills formations. Deeper formations of

secondary importance include the Dakota Group, Lyons Sandstones, Fountain Formation, and also Pre-Cambrian granites (Livingston, et. al. 1976).

The alluvium is the most permeable aquifer, with 200 times the capacity to accept recharge water than the Laramie-Foxhills aquifer (at an average permeability of 6,000 gallons per day per square foot versus 30 gallons per day per square foot).

Recharge of aquifers occurs where the formation intersects the surface, or is buried by water-bearing strata. Methods of recharge include: percolation of surface precipitation, streamloss into underlying sediments, migration of water from one formation to another, and recharge from man-induced conditions.

The chief source of aquifer recharge on PAFB is from stream loss out of the East Fork of Sand Creek which flows across the northwestern boundary of the base. This stream crosses both Quaternary Alluvium and bedrock formations and thus is a potential source of recharge for these intersecting aquifers. Secondary sources of recharge include precipitation and irrigation. It is plausible that the alluvium may receive some seepage from juxtaposed bedrock, as occurs along Monument Creek northwest of PAFB. Ground water movement appears to be directed south-southwest, out from the center of the Denver Basin.

There exist two main types alluvium on PAFB, most of the area being covered by the Broadway Alluvium laid down during the Pleistocene Pinedale Glaciation. The Broadway Alluvium consists of poorly sorted, yellowish-brown, coarse sand, with high permeability. The more recent Piney Creek Alluvium (Upper Holocene) occurs along the East Fork of Sand Creek in its flood plain. This sediment is poorly sorted, grey to brown, humic-rich, firmly compacted, clayey silt and sand up to 20 ft thick. It is distinguished from Broadway Alluvium chiefly by a greater clay and silt content and an associated low to medium permeability.

The Laramie-Foxhills aquifer outcrops on the northwest margin of PAFB, along the east fork of Sand Creek. The Laramie is a dark grayish-brown,

iron-stained, fine-grained sand containing seams of lignite reaching thicknesses of up to 250 ft. Thin sandstone beds in the lower part of the Laramie yield moderate supplies of water. The Foxhills Sandstone is a light olive-gray, thin-bedded, friable sandy shale in the upper half and a massive, friable sandy shale in the lower half. The lower sandstone beds in the Laramie, combined with the upper beds of the Foxhills sandstone form the Laramie-Foxhills aquifer.

The Dakota Group sandstones are finegrained, cross-bedded sandstone forms that are relatively well lithified having medium permeabiltiy at best. The Dakota is capable of yielding 200 gallons per minute when the formation is completely penetrated and fractured.

The Lyons Formation is a red and yellowish-grey, fine grained sandstone with localized conglomerate. Minor quantities of water are recovered from the Lyons in some areas of El Paso County from localized areas where permeability is of medium range.

The Fountain Formation is a reddish-brown, maroon, coarse, arkosic conglomeratic detritus up to 4,400 ft thick with medium to low permeability. Water yield is generally less than 10 gallons per minute near the foothills. This formation is generally not considered to be an aquifer.

Precambrian granitic and metamorphic rocks yield water to wells and springs in areas. Permeability is low to nonexistent except along joints, fractures, and weathered zones.

Shallow borings, taken from four construction areas on PAFB contribute information about the water table and the near-surface lithology. The construction sites were: The Civil Engineering Building (1324), the planned NORAD SPACECMD Headquarters and the associated Sanitary Sewer extention, and the Maintenance/Fuel System Dock (208) (Figure 3.3-6).

Recorded water depths (Table 3.3-1) indicate that the water table dips south-southeast from the East Fork of Sand Creek at 64 ft per mile. The

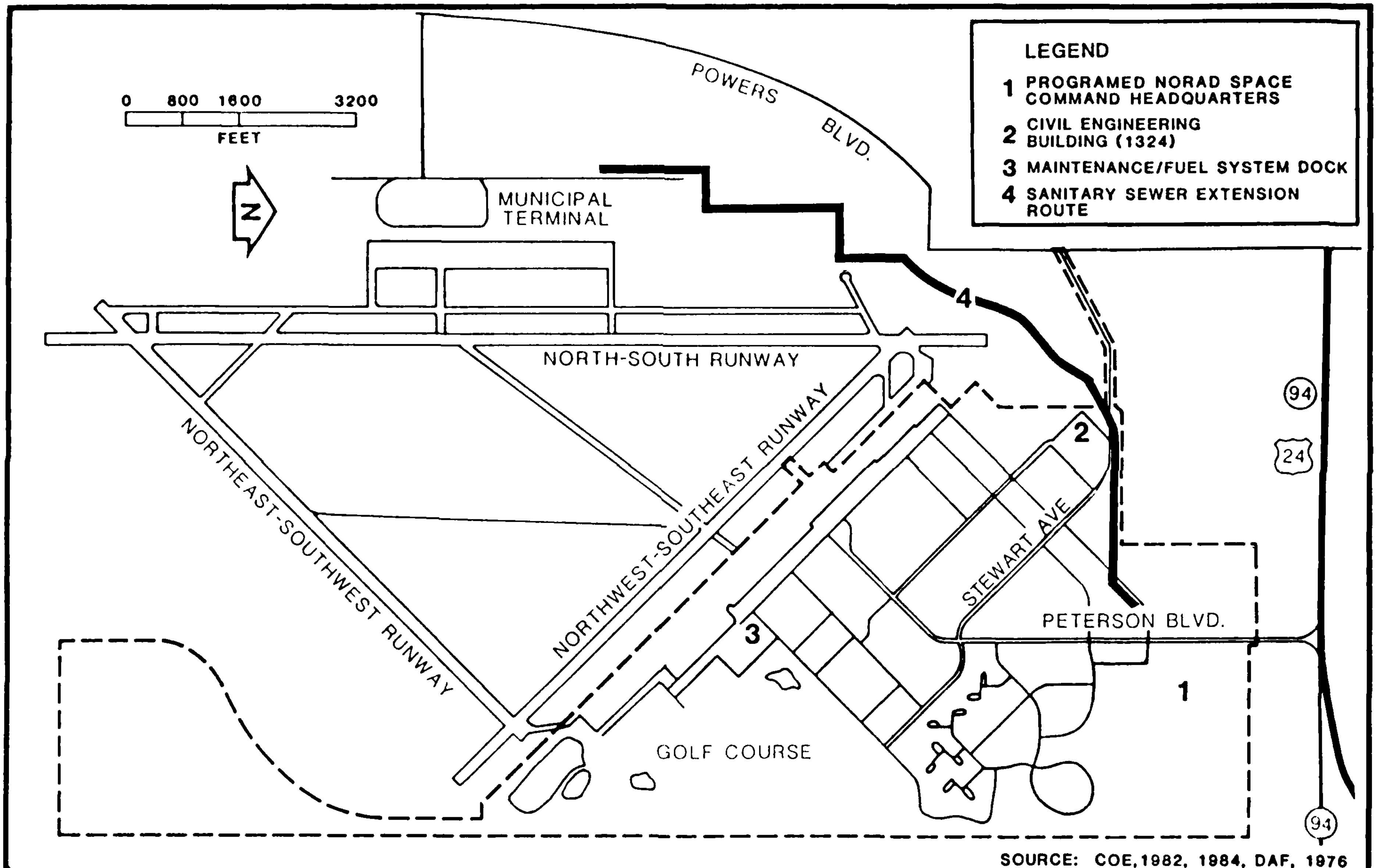


Figure 3.3-6
SOIL BORING LOCATIONS

INSTALLATION
RESTORATION PROGRAM
Peterson Air Force Base

Table 3.3-1. Recorded Water Depths - PAFB (Page 1 of 2)

	Boring Identification	Surface Elevation	Water Table	Depth to Water
NORAD and SPACECMD Headquarters Site				
	DH 83-3	6259.3	6247.0	12.3
	DH 83-4	6258.4	6241.0	17.4
	DH 83-5	6257.8	6245.0	12.8
	DH 83-6	6257.1	6237.0	20.1
	DH 83-7	6257.1	6243.0	14.1
	DH 83-8	6256.3	6247.0	9.3
	DH 83-9	6256.1	6245.0	11.1
	DH 83-10	6256.4	6243.0	13.4
	DH 83-11	6256.0	6241.0	15.0
	DH 83-12	6254.9	6248.0	6.9
	DH 83-13	6254.7	6233.0	21.7
	DH 83-16	6254.4	6241.0	13.4
	DH 83-17	6254.5	6237.0	17.5
	DH 83-18	6254.8	6239.0	15.8
	DH 83-19	6253.4	6245.0	8.4
	DH 83-20	6253.5	6238.0	15.5
	DH 83-36	6254.3	6237.0	17.3

Table 3.3-1. Recorded Water Depths - PAFB (Continued, Page 2 of 2)

	Boring Identification	Surface Elevation	Water Table	Depth to Water
NORAD and SPACECMD Headquarters Site				
	DH 83-37	6252.6	6240.0	12.6
	DH 83-38	6254.0	6240.0	14.0
Maintenance Fuel System Dock				
	DH 82-1	6173.5	6153.5	20.0
	DH 82-2	6172.2	6152.0	20.2
	DH 82-3	6170.6	6150.5	20.1
	DH 82-4	6166.9	6151.5	15.4
	DH 82-5	6153.3	6144.5	8.8
	DH 82-12	6177.3	6154.0	23.3
Sanitary Sewer Extension				
Route	DH 83-27	6216.21	6202.0	14.21
	DH 83-28	6215.56	6197.0	18.56
	DH 83-31	6199.57	6181.0	18.57
	DH 83-32	6173.93	6156.0	17.93
	DH 83-33	6151.96	6144.0	7.96
	DH 83-34	6133.91	6123.0	10.91

Source: ESE, 1984

near-surface lithology of the area consists generally of 10 to 25 ft of silty sand underlain by varying thicknesses of gravelly sand and/or clay,interbedded with more fine to medium-grained sands. There is an apparent increase in clay thickness and occurence near the creek at the Civil Engineering Building construction site (Up to 20 ft thick). Thin seams of clay (1-3 ft) are interbedded with the silty sand at the NORAD SPACECMD Headquarters site. Sandy clay (x-y ft) is interlayered with sands Throughout the route of the sewer extension project. Clay primarily occurs interstially at the Fuel/Maintenance Dock, which is located the greatest distance from the East Fork of Sand Creek.

3.4 WATER QUALITY

3.4.1 SURFACE WATER

The dissolved-solids concentration of surface water at PAFB ranges between 250-500 milligrams per liter (mg/l) during low flow conditions (Livingston, et. al., 1976). Dissolved solids concentation of the stream water is inversely proportional to the volume of stream discharge. Thus, during the wettest month (May), the dissolved-solids concentration becomes diluted to less than half the value at low flow conditions. Water used by PAFB is purchased from the City of Colorado Springs and meets drinking water standards. There is a coinciding lack of specific analytical data concerning the surface and ground water quality at PAFB.

3.4.2 GROUND WATER

Occurence and Quality of Ground Water

The chemical characteristics of the ground water at PAFB are dependent upon the physical qualities of the aquifer in which it is stored. The Colorado Conservation Board has published a table listing general chemical of the aquifers in El Paso County. The following is a synopsis, beginning with the oldest aquifer:

1) Precambrian Granitic and Metamorphic Rocks: Dissolved solids concentrations are normally less than 200 mg/l. Fluorides generally exceed 2.0 mg/l. (Upper limit).
2) Fountain Formation: The water quality of this formation is variable due to localized evaporite units in the formation. Dissolved solids concentrations of up to 3,150 mg/l have been

recorded. In areas of recharge, these concentrations generally are less than 500 mg/l. Concentrations of fluorides have been recorded at levels up to 7.1 mg/l.

3) Pierre Shale: This unit does not readily transmit water, however limestone members may yield small quantities of water from fractured zones. Dissolved solids concentrations range from 485 mg/l to 4,080 mg/l. The lower concentration values are attributed to sandstones of the upper transition units of the Pierre Shale in the eastern portion of El Paso County.

4) Laramie-Foxhills Aquifer: The dissolved solids concentrations of water from the Laramie-Foxhills aquifer range from 134 mg/l to 744 mg/l, but generally fall below 400 mg/l. The water is soft and has a high sodium content.

5) Slocum and Verdos Alluviums Undivided: The dissolved-solids concentration of water from the Slocum and Verdos Alluviums ranges from 96 mg/l to 755 mg/l along Fountain Creek.

6) Broadway Alluvium: The part of the Broadway Alluvium known as the Widefield aquifer ranges in dissolved-solids concentation from 409 mg/l to 598 mg/l. Nitrate concentrations range from 3.1 mg/l to 34 mg/l.

7) Eolian Sand: Water from eolian sand deposits contain dissolved-solids concentrations that range from 179 mg/l to 804 mg/l. The majority of concentrations fall below 300 mg/l.

8) Piney Creek Alluvium: The chemical quality of water from these alluvial deposits is variable. Water from Piney Creek alluvium southwest of Colorado Springs along Fountain Creek has a dissolved-solids concentration which ranges 364 mg/l to 3,690 mg/l. The Big Sand Creek concentrations range from 623 mg/l to 1,170 mg/l. Dissolved-solids concentrations range from 0.1 to 5.8 mg/l.

3.5 BIOTA

PAFB and NCMC lie within the Pikes Peak region of Colorado, an area which contains several distinct plant zones. This vegetation zonation is determined by altitude, precipitation, and soils, and includes:

1. The plains or prairie grassland zone at elevations below 6,000 ft, with precipitation ranging from 10 to 15 inches per year (in/yr). These grasslands are dominated by grasses, sedges, and forbs, with woody species occurring along streambeds.
2. Intermediate zones, including the montane and foothill plant zones occurring between 6,000 and 9,000 ft above mean sea level. These zones, which comprise the lower limits of forested mountain slopes and foothills, are dominated by ponderosa pine, Douglas fir, and scrub oak.
3. Two high-altitude zones, including the sub-alpine and the alpine zones, located between 9,000 and 10,000 ft and higher than 10,000 ft, respectively. Tree and shrub species predominate in the sub-alpine zone, herbaceous species and dwarf shrubs in the alpine zone.

Plains grasslands cover PAFB, while foothills grasslands and montane forest cover NCMC. The dominant vegetation associations are the Pinyon-Juniper association within the montane forest at NCMC, and the Blue Grama-Buffalo Grass association, which is widespread throughout El Paso and Pueblo Counties and comprises the dominant vegetation association at PAFB. This association is dominated by mid- and short-grasses and forbs, but the original species composition has been altered by grazing and cultivation. The Cottonwood-Willow association, dominated by riparian woody species, forbs, and grasses is largely restricted to streambeds, ponds, and reservoirs.

Resident mammal species in El Paso County include mule deer, pronghorn, black bear, bobcat, mountain lion, coyotes, black-tailed prairie dog, squirrels, and rabbits. Population sizes and conditions vary with vegetation and habitat conditions. A large variety of bird species reside on or migrate through the area due to location and habitat diversity. Grassland and woodland species dominate the avifauna, and mourning dove and scaled quail are common game species. In contrast, waterfowl populations are limited due to the absence of extensive surface water. The golf course lakes are managed as cold-water fisheries for trout and catfish.

4.0 FINDINGS

This chapter presents information for PAFB and NCMC on wastes generated by activity, describes past waste disposal methods, identifies the disposal and spill sites located on the base, and evaluates the potential for environmental contamination. This information was obtained by a review of files and records, interviews with present and former Air Force and base employees, and site inspections.

4.1 ACTIVITY REVIEW

4.1.1 INDUSTRIAL OPERATIONS

Industrial operations at PAFB are related to maintenance of aircraft, heavy equipment, motor vehicles, and base facilities. The major units involved in maintenance activities are the 901 CAMS, 1001 CES, and 1001 TRNSS. These units provide a variety of services including oil and fluids changes, minor engine maintenance, painting, radiator repair, and hydraulic system repair.

Industrial operations at NCMC are limited to operation and maintenance of the complex, which involves primarily electrical generation and distribution and interior painting. Electricity for the complex can be self contained, operated by a set of large diesel powered generators within the main complex. The operation and maintenance of these generators is the largest industrial operation at the facility.

The mission of PAFB has changed several times over the years, and thus the specific maintenance operations and the level of activity have changed as well. In general, the industrial operations have always been those associated with aircraft and vehicle operations such as painting, engine repair, and aircraft systems maintenance. However from approximately 1960 to 1975, PAFB had flying missions which resulted in a higher level of aircraft operations than at present. The primary aircraft used during this period were the T-33 and T-37. The number of aircraft at PAFB rose gradually from 1960, peaking at 98 in 1968 and then declining. During this same period, the engine shop in Building 502 served as a depot level maintenance facility.

Currently, aircraft maintenance operations under the 901 CAMS include the corrosion control and pneudraulics/environmental systems shops in Building 625, the wheel and tire shop in Building 208, and field maintenance in Building 130. Shops of the 1001 CES operate out of a consolidated maintenance facility in Building 1324. The 1001 TRANS vehicle maintenance and painting operations are located in Building 1255.

Training activities include firefighter training. Exercises are conducted at a facility constructed in 1977, which is equipped for fuel storage and runoff control. Before 1977, exercises were conducted in a shallow, unlined pit just inside the eastern base boundary.

4.1.2 FUELS/OILS HANDLING AND STORAGE

The main fuel used at PAFB is jet fuel (JP-4). Additional fuels and oils stored and used in quantity are gasoline (MOGAS), and diesel fuel (DF-2). The largest storage point is the group of tanks adjacent to Building 668, at the north end of the flight line. Tank 14 is the largest single tank, containing 210,000 gallons of JP-4. Secondary containment at this location is provided by an asphalt-sealed earthen berm enclosing an unlined area. Various underground tanks ranging in capacity from 6,000 to 12,000 gallons are used to store the other products (see Table 4.1-1).

Refueling of aircraft is performed on the flight line. Fuel is transported from the storage tanks in tank trucks with capacities of 3,000 to 5,000 gallons. Trucks are filled from a transfer point in the fuels yard at the north end of the flight line. No secondary containment is provided at this location. Personnel from base fuels operate and maintain the fuel storage and distribution system. Storage tanks, valves, and piping are inspected daily to check for conditions which pose a fire or spill hazard. Underground tanks are leak checked quarterly.

The main fuel stored at NCMC is DF-2, most of which is used in electric power generation. The largest storage location is an underground reservoir within the main complex. Other tank locations are given in Table 4.1-1.

Table 4.1-1. POL Storage Location - PAFB

Tank Number	Building Number	Capacity (Gal)	Above/Below Ground	Pollutant
PAFB				
1-8	668	8 @ 25,000	BG	JP-4
9-11	668	3 @ 12,000	BG	JP-4
12	668	12,000	BG	DF-2
13	668	12,000	BG	MOGAS
14	668	210,000	AG	JP-4
15	1232	9,988	BG	MOGAS
16-18	1232	6,016	BG	MOGAS
19	1232	9,988	BG	DF-2
20	3698	210,000	AG	JP-4
NCMC				
1	302	2,000	BG	DF-2
2	302	1,000	BG	MOGAS
3	302	1,000	BG	MOGAS
4	100	1,000	BG	DF-2
5	NA	6,000	BG	DF-2
6	NA	500,000	BG	DF-2
7	NA	6,000	AG	Oil
8	NA	4,000	AG	Waste Oil

Source: PAFB, 1983; NCMC, 1984.

4.1.3 PESTICIDE/HERBICIDE HANDLING AND STORAGE

The mixing and bulk storage locations for pesticides/herbicides at PAFB are in Building 1324. Small containers of some materials are stored in Building 206. Handling, storage, and applications of pesticides and herbicides is carried out in accordance with the PAFB Pest Management Plan and applicable state and Federal regulations. There are no stocks of restricted pesticides on hand. Table 4.1-2 lists pesticides and herbicides used at PAFB and the approximate quantities used annually.

Waste generation associated with pesticide and herbicide use is limited to empty containers, rinseate and wastewater generated from cleaning spraying equipment. Since 1975, when Building 1324 was built, containers have been triple-rinsed and disposed of as solid waste with the rinse water used in subsequent mixing. Spraying equipment is washed at the wash rack at Building 1324. The rack drains to an oil/water separator which is periodically pumped out and the material is drummed for contract disposal. Washing was previously conducted in the wash rack at Building 674 with mixing done in the driveway outside Building 675.

4.1.4 PCB HANDLING AND STORAGE

Analyses have been performed on approximately 30 percent of the in-service transformers at PAFB, and one PCB item has been found. Based on a name plate survey, some in-service items are classed as potentially contaminated or containing PCB's. These items are labeled accordingly and inspected quarterly for leakage. During the name plate survey, five leaking items were found. These were sampled and found free of PCB's. The PCB storage area in Building 1321 is used to store items which come out of service until analyses are available. Appropriate disposal is then arranged through DPDO.

Site surveys are currently underway at NCMC to quantify the amount of PCB oil contained in the electrical equipment onsite. It has been determined that 73 Electromagnetic Pulse (EMP) filters currently in service include capacitors which contain PCB oil at levels of approximately 420,000 ppm.

Table 4.1-2. Pesticide Storage (Page 1 of 2)

MRL Number or National Stock Number	Description	Authorized Quantity	Unit of Issue
6840-00-753-4973	Rodenticide bait	10	5 lb can
6840-00-089-4664	Rodenticide bait block	3	cases
6840-00-264-6684	Rodenticide calcium cyanide	3	5 lb can
6840-00-84-7355	Insecticide Diazinon solution	50	1 gal can
6840-00-782-3925	Insecticide Diazinon E.C.	6	1 gal pail
6840-00-753-5038	Insecticide Diazinon dust	2	25 lb pail
6840-00-180-6069	Insecticide Baygon solution	5	1 gal can
6840-00-685-5438	Insecticide Malathion E.C.	6	5 gal can
6840-00-782-3927	Insecticide Sevin W.P.	10	10 lb bag
6840-00-067-6674	Insecticide aerosol	72	12 oz can
6840-00-402-5411	Insecticide Dursban	2	5 gal can
6840-00-242-4217	Insecticide Lindane powder	3	boxes
6810-00-597-6111	Insecticide, napthalene	24	1 lb box
6840-00-664-7060	Herbicide, 2-4-D amime	5	5 gal can
HB020	Grass hopper bait	10	5 lb can
K1002	Insecticide wasp spray	2	DZ
LP	Bird stop	6	can
LP	Supreme oil spray	10	1 gal can

Table 4.1-2. Pesticide Storage (Continued, Page 2 of 2)

MRL Number or National Stock Number	Description	Authorized Quantity	Unit of Issue
LP	Methoxychlor E.C.	4	1 gal btl
6840-L000-436-4500	Diazinon granular	12	1/2 bag
LP	Tersan LSR	24	3 lb bag
LP	Tersan 1991	96	2 lb bag
6840-L00-3371-4500	Tersan SD	24	3 lb bag
6840-L00-1944-2500	Pine/ornamental spray	25	1 gal
6840-L00	Fungicide Daconil 2787	12	2 gal
6840-L00	Sticker-extender	5	1 gal
KH003	Herbicide Pramtol	50	5 gal can
KH002	Herbicide roundup	50	5 gal can
HG007	Growth retardant	2	20 gal drum
KH001	Herbicide trefian	60	50 lb bag
LP	Soda Ash	1	100 lb bag
KS001	Sodium silicate	1	1 gal can
LP	Herbicide Trimec	50	5 gal can
LP	Herbicide surfian	48	1 qt btl
LP	Fungicide bayleton	44	1 pt jars

Source: PAFB, 1983.

4.2 HAZARDOUS WASTE GENERATION/DISPOSAL

4.2.1 GENERATING OPERATIONS

PAFB engineering personnel provided a hazardous waste inventory which they had compiled. This listing was used as the basis for identifying shops on the base and making a preliminary assessment of the types and quantities of waste generated by the various operations. Interviews were conducted with personnel from each of the major waste generation points. Telephone contacts were made with smaller operations. In each interview, personnel were asked to verify or update the types and quantities of waste generated as reported. By locating personnel who had long employment histories, information was obtained on how waste generation patterns had changed over the years. These interviews also provided the information on disposal methods presented in Section 4.2.2.

Information obtained on the major waste generating operations is summarized in Table 4.2-1. Not all the wastes listed are hazardous wastes as defined by the State of Colorado, but have been included to provide a complete picture of the range and quantity of wastes generated which require controlled disposal. A master list of facilities and shops at PAFB and their waste generation status is presented in Appendix D.

The main types of waste generated at PAFB and NCMC are fuel, oils and solvents, and paints and paint strippers. Waste fuel, oil, and solvents include JP-4, engine oil, PD680, and MEK which are derived primarily from periodic maintenance and engine repair operations. Waste consisting of paint residue, strippers and thinner is generated by the parts, and vehicle painting operations.

The fire suppressant currently employed at PAFB is AFFF. It is reported that, at least in some applications, carbon tetrachloride was employed until appoximately the mid-1950's. The use of chlorobromomethane followed carbon tetrachloride and may have been utilized until the early 1970's. The extent to which these suppressants were utilized and the manner of their disposal at PAFB was not documented.

Table 4.2-1. Waste Generation and Disposal (Page 1 of 3)

Shop Name	Location Present	Location Past	Waste Material	Current Waste Quantity (gal/mo)	Methods Treatment, Storage, and Disposal 1950 / 1960 / 1970 / 1980
901 CAMS					
Corrosion Control	625		Paint thinner	15	STD / CD
			Paint sludge	30	STD / CD
			Methyl Ethyl Ketone	15	STD / CD
			Methylene Chloride	10	STD / CD
Wheel and Tire	208		Paint Stripper	10	Landfill/STD / CD
Pneudraulics/ Environmental Systems	625		Carbon Remover	1	CD
			PD-680	10	FTA / CD
Field Maintenance	130		7808 Oil	55	CD
			Hydraulic Fluid	55	STD / CD
			PD 680	10	FTA / CD
			JP-4	250	FTA / FTA/REUSE

———— Data confirmed by shop personnel.
– – – – Estimated from secondary sources.

Landfill - Buried in on-base landfill.
FTA - Firefighter Training Area
SS - Sanitary Sewer.
REUSE - Added to bulk storage supply.
STD - Storm Drain.
CD - Contract Disposal via DPDO or service contract for recycling.

Table 4.2-1. Waste Generation and Disposal (Continued, Page 2 of 3)

Shop Name	Location Present	Location Past	Waste Material	Current Waste Quantity (gal/mo)	Methods Treatment, Storage, and Disposal 1950 – 1960 – 1970 – 1980
1001 CES					
Paint	1324		Paint Thinner	5	Landfill/STD — CD
			Paint/Sludges	5	Landfill — CD
Power Production	1324		Motor Oil	30	FTA — CD
1st SSG Logistics					
Propulsion	140	502	Motor Oil	30	FTA — CD
			7808 Oil	5	CD
AGE	503		Motor Oil	50	FTA — CD
			PD-680	50	FTA — CD

______ Data confirmed by shop personnel.
\- - - - - - Estimated from secondary sources.

Landfill - Buried in on-base landfill.
FTA - Firefighter Training Area
SS - Sanitary Sewer.
REUSE - Added to bulk storage supply.
STD - Storm Drain.
CD - Contract Disposal via DPDO or service contract for recycling.

Table 4.2-1. Waste Generation and Disposal (Continued, Page 3 of 3)

Shop Name	Location Present	Location Past	Waste Material	Current Waste Quantity (gal/mo)	Methods Treatment, Storage, and Disposal 1950 – 1960 – 1970 – 1980
1001 TRANS					
Paint	1255		Paint Thinner	25	Landfill – CD
			Paint/Sludge	25	Landfill – CD
Vehicle Maintenance	1255		Motor Oil	150	FTA – CD
MWR					
Auto Hobby	640		Motor Oil	75	FTA – CD
Aero Club	104		Motor Oil	7	FTA – CD
OLJ-CEMIRT	119		Toluene	5	CD
			Motor Oil	30	CD
NCMC					
Power Plant	12132		Motor Oil	1000	CD
Facilities Maintenance	6045		TCE	55	CD
			MEK	30	CD

——— Data confirmed by shop personnel.
– – – Estimated from secondary sources.

Landfill - Buried in on-base landfill.
FTA - Firefighter Training Area
SS - Sanitary Sewer.
REUSE - Added to bulk storage supply.
STD - Storm Drain.
CD - Contract Disposal via DPDO or service contract for recycling.

4.2.2 DISPOSAL METHODS

Information obtained on waste disposal methods is summarized graphically in Table 4.2-1. Practices used before 1960 were undocumented and difficult to substantiate. It is known that the original base construction included a number of septic tanks and dry wells, presumably for sewage disposal and floor drainage. In 1944, the septic tanks were abandoned, and the system was connected to the Colorado Springs sewage treatment plant. By 1956, the wet wells were abandoned, and drainage from the flightline areas was connected to an "industrial drain line". This line transported drainage from inside hangars and maintenance areas to the south end of the flightline. Flow was passed through a large septic tank used as an oil water seperator and then discharged into a leach field located in the present golf course. The industrial drain was connected to the sanitary sewer system in 1976.

Solid waste disposal in the early years consisted of burial in a series of landfills. The first two of these were located in the northwest corner of the base. They were used from 1953 to 1961, and possibly earlier. The third site is on the south boundary and was used until 1972, when solid waste disposal was contracted out. Very little waste segregation was practiced, and no controls were placed on materials buried in the landfills. However, during the period of landfilling on base both the industrial drain line and the firefighter training area were used for disposal of liquid waste. In addition, contract sale of waste oil and mixed flammable liquids was initiated in the early 1960's. Thus, disposal of liquid waste was probably limited to incidental dumping of small containers.

By 1980 the existing procedures for segregating waste and contract disposal through DPDO at Ft. Carson were being implemented. Sale of mixed liquids was discontinued according to contractor specification fo materials acceptable for recycling. Fuel used for firefighter training was restricted to JP-4 supplied through the fuels management office. These procedures resulted in elimination of onbase waste disposal, with the exception of construction rubble placed at the Old Southeast Landfill.

Disposal practices in the early years at NCMC were hard to document do to the lack of long-term employees, but seem not to have varied too much over the years, with the exception of increased segregation of waste liquids. Before 1982, petroleum based solvents were used for parts cleaning instead of TCE and MEK. These solvents were reportedly disposed of in the waste oil tank, the contents of which were sold for recycling. All materials are now segregated, containerized, and disposed of through DPDO at Ft. Carson.

4.2.3 SPILLS AND INCIDENTAL DISCHARGES

Only one reportable spill has occured at PAFB. In 1981, a valve failure in the fuel yard at Tank 14 resulted in a 1,200 gallon spill of JP-4. The fire department responded to this incident, flushing the fuel from the area into surface drainage channels. No containment was attempted, and no subsequent cleanup operations were conducted.

Records obtained from NCMC indicate seven documented spills occurred between 1978 and 1982. All spills occurred inside the mountain, and resulted in contamination reaching the oil/water seperator on the drainage line. The largest spill involved an estimated 800 gallons of lubricating oil. Approximately 50-80 gallons of oil was discharged to the receiving stream, the remainder was contained. The other spills involved from 5 to 200 gallons of diesel fuel and/or oil. In several cases, contaminants were observed to pass the oil/water seperator. In the last incident in January 1982, analysis indicated up to 50 ppm oil/grease in the receiving stream. Cleanup actions including absorbents were undertaken and levels were reduced to <2.0 ppm within two days. Written notice of this spill was provided to the U.S. Environmental Protection Agency.

4.3 AREAS OF POTENTIAL CONTAMINATION

The investigation identified seven areas of potential contamination associated with the Peterson Complex. All sites were located within the present PAFB boundaries (Figure 4.3-1) and resulted from handling and disposal of industrial and/or hazardous waste. Aerial photographs of the respective sites are provided in Appendix E.

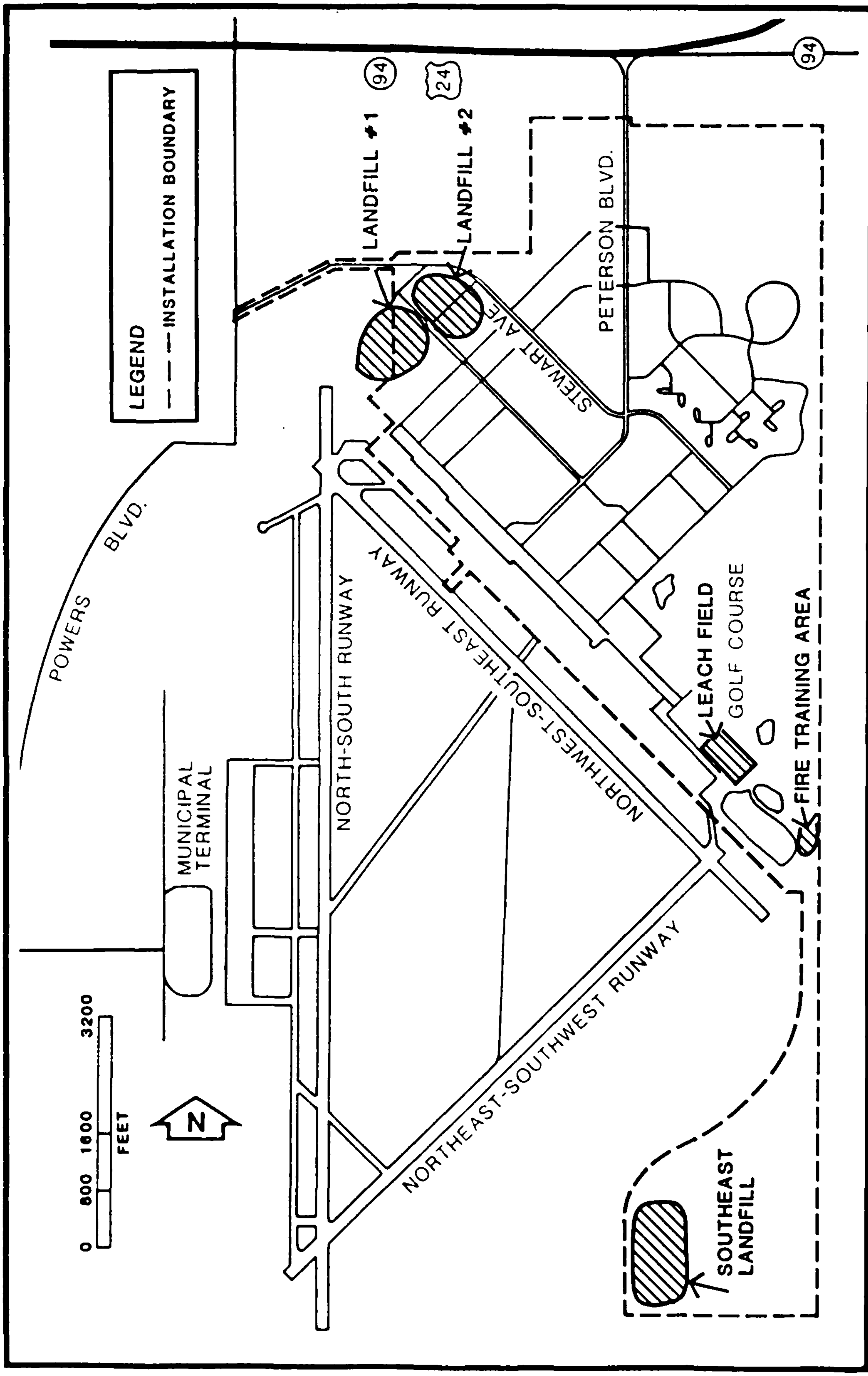


Figure 4.3-1
AREAS OF POTENTIAL CONTAMINATION

INSTALLATION RESTORATION PROGRAM
Peterson Air Force Base

East Fork Sand Creek Landfill #1

Located just inside the west entrance and adjacent to the East Fork of Sand Creek, the landfill was used from the late 1940's to 1953-1954. Originally a gravel pit some 45 to 60 ft deep, the site was used for general purpose disposal. Operating personnel reported wastes consists mostly of household solid wastes, contruction rubble, and to a limited extent empty barrels and drums. Incidential disposal of industrial liquids was limited. Most of the area is currently open and unused.

East Fork Sand Creek Landfill #2

Landfill #2 is adjacent to Landfill #1 and was in operation from 1954 to 1961. Reportedly some 40 ft deep, the pit was originally a gravel pit. The site was operated as a general purpose landfill but may have taken some industrial materials exclusive of drummed liquids. The site was partially excavated during contruction of the CE and Transportation Facilities. Removed material was disposed of in the Southeast Landfill. Substantial quantities of water were reported saturating the subsurface during excavation. The site currently underlies permanent structures and paved parking lots.

Southeast Landfill

In operation from 1962 to present, the landfill is located just inside the south boundary, southwest of the pistol range. With few exceptions the landfill, since 1972, has been restricted to construction rubble disposal. The exceptions include material excavated during the Leach Field Reclamation, construction of the CE and Maintenance Facilities and reclamation of the first fire training area (Firefighter Training Area #1). Reports indicate that in addition to the above excavation material, the landfill contains mostly solid waste and possibly some small amounts of paint and other shop waste. Since 1972 contract hauling of wastes has been the disposal procedure.

Firefighter Training Area #1

This area is located north-northeast of the end of runway 12/30, just inside the east boundary. Reports indicate that the area was a shallow open pit that was filled with flammable liquid and ignited. Clean fuel

was generally used in the training exercises but other liquids (oils, solvent) were also routinely included. This site was abandoned in 1977, when a new Firefighter Training Facility was constructed.

East Boundary Leach Field

Designed as an industrial waste drain system, reports indicate a problem plagued history regarding its operation. The system consisted of a settling tank and oil skimmer for solid, oil, and sludge containment and a gravel enveloped Leach Field for effluent disposal. The field received inflow from the industrial waste line constructed to replace the dry wells on the flight line. This line was the main disposal point for industrial liquids beginning in approximately 1956. As noted the system was beset by operational problems and the efficiency of the settling tank and skimmer are questionable. Use of the system was discontinued in 1978 when the industrial drain line was connected to the sanitary sewer system.

Industrial Area Storm Sewers

Prior to 1978, some shops at PAFB routinely used storm drain inlets to dispose of liquid waste. This is most noticeable at the Corrosion Control Shop in Building 625 where the inlet shows ample visible evidence of having been used to dump paint waste over a long period. Wastes disposed of in this manner would ultimately have reached an outfall just east of the East Boundary Leach Field where the present golf course pond is located.

Fuel Yard

This area at the west end of the fuel yard was the site of a 1,200 gallons JP-4 spill in 1981. Spilled fuel was flushed to surface drainage channels.

Oil/Water Separator

This separator is on the main drainage line from the underground portion of NCMC, which provides a means of discharging cooling water. Liquid is collected in a sump beneath the main facilities and pumped out of the mountain. It drains through the separator and into a natural surface

channel. Handling of fuels, oil, solvents, and paints within the complex creates the potential for spillage and resulting contaminant discharges through this route.

4.4 HAZARD ASSESSMENT

Of the seven areas of potential contamination identified, five were determined to require rating with the HARM system, based on the decision tree presented in Figure 1.3-1. The storm sewers Fuel Yard, and oil/water seperator were eliminated at this point due to the lack of need for further IRP action (see Table 4.4-1). Any residual contamination from the storm sewers would be found in the east boundary leachfield area, which was rated using HARM. For the Fuel Yard, the limited fuel quantity spilled, evaporation, and dilution would have effectively eliminated the potential for residual contamination. The NCMC oil/water seperator has reportedly not been used historically as a method of industrial and/or hazardous waste disposal, and has been operated under NPDES regulations as a stormwater discharge.

Each of the remaining sites discussed in Section 4.3 was rated using the HARM. The HARM scores are summarized in Table 4.4-2. The process of rating potential hazards using the HARM system is described in detail in Appendix F. Basically the method uses numerical ratings for a number of discrete variables to calculate subscores for three categories. These categories represent the risk of human exposure (Receptors), the nature and quantity of waste (Waste Characteristics), and the potential migration routes (Pathways).

Evaluation of some variables within the Receptor subscores required some judgement in using available information. In particular, the distance to the nearest well and the populations served by ground water in the vicinity could not be established with certainity using available information. Instead of leaving this critical factor out of the calculation, guidance provided in the National Oil and Hazardous Substances Contingency Plan (40 CFR 300) for use of the EPA Hazard Ranking System (HRS) was applied since this system was the basis for HARM. Specifically, occupied dwellings which are not within the service

Table 4.4-1. Site Screening Results

Site	Potential Hazard	Further IRP Action	Apply HARM
Landfill #1	Yes	Yes	Yes
Landfill #2	Yes	Yes	Yes
Southeast Landfill	Yes	Yes	Yes
FFTA #1	Yes	Yes	Yes
Leachfield	Yes	Yes	Yes
Storm Sewers	Yes	No	No
Fuel Yard	Yes	No	No
Oil/Water Seperator	Yes	No	No

Source: ESE, 1984

Table 4.4-2. Summary of HARM Scores

Rank	Site	Receptors Subscore	Waste Characteristics Subscore	Pathway Subscore	Waste Management Factor	Total Score
1	Landfill #1	59	37	80	1.0	59
2	Landfill #2	59	37	80	1.0	59
3	East Boundary Leach Field	33	80	42	1.0	52
4	Firefighter Training Area #1	31	48	35	1.0	38
5	Southeast Landfill	31	20	35	1.0	29

Source: ESE, 1984.

area of any public water supply and had no other reported water source were assumed to have a private well. Populations were estimated by map inspection and ground tours of neighborhoods, assuming an average of four persons per household (see Section 3.4.2).

Waste characteristics were evaluated based on information obtained in interviews with base personnel. In cases where the waste was a mixture of substances with differing characteristics, the most critical waste was used for each variable. For example, a mixture of metal treatment sludges and waste solvents might be rated high for flammability due to the solvents and high for presistence due to the metals in the sludge. This is based on the guidance provided for HRS.

For the Pathways subscore, environmental factors such as rainfall intensity and net precipitation were evaluated using standard references such as the Climatic Atlas of the United States (USDC, 1979). Erosion potential was based on direct observation, while depth to ground water was based on available boring logs, geologic data, and interviews. A multiplication factor to account for Waste Management Practices is applied to the average of the three subscores to yield a final score. HARM provides only three choices, 1.0, 0.95, and 0.1, to indicate no containment, limited containment, and fully contained and in full compliance.

5.0 CONCLUSIONS

The goal of the IRP Phase I study is to identify sites where there is potential for environmental contamination resulting from past waste disposal practices and to assess the probability of contaminant migration from these sites. These conclusions are based information collected from the Project Team's field inspection, review of records and files, review of the environmental setting, and interviews with base personnel, past employees, and state and local government employees.

East Fork Sand Creek Landfill #1 (Site 1)

This location at the northwest corner of the base was originally a gravel pit. It was used as a general purpose landfill from the late 1940's until 1953 or 1954. It is located adjacent to an alluvial channel where contact with ground water is indicated. Although disposal of industrial waste was reportedly limited, potential exists for contaminant migration, primarily involving solvents, oils, metals, and pesticides. This site scored 59 on HARM.

East Fork Sand Creek Landfill #2 (Site 2)

Located adjacent to Landfill #1, this site has a similar disposal history and geohydrologic conditions. It was operated from 1954 to 1961. This site was partially excavated during subsequent construction of Building 1324, which now occupies the site. Potential for contaminant migration of solvents, oils, metals, and pesticides exists. This site scored 59 on HARM.

East Boundary Leach Field (Site 3)

Used as a disposal facility for flow from the industrial drain line from 1956 to 1978, this site was subsequently regraded during golf course construction. Local ground water conditions are unclear. Potential exists for contaminant migrations by solvents, oils, metals, and pesticides. This site scored 52 on HARM.

Firefighter Training Area #1 (Site 4)

Firefighter training exercises were conducted in this shallow, unlined pit until 1977. Exercises were generally conducted using JP-4 as fuel. However, other liquids including waste oils and solvents were sometimes included. Local ground water conditions are somewhat uncertain, but no major aquifers or alluvial channels are present. Soil contamination with oils and solvent is likely. This site scored 38 on HARM.

Southeast Landfill (Site 5)

This site began operation in 1962 as a general purpose trench and cover landfill. In 1972, contract hauling of solid waste began, and subsequent landfilling was largely limited to construction rubble. Local ground water conditions are somewhat uncertain, but no major aquifers or alluvial channels are present. Potential for contaminant migration involves oils, solvents, metals, and pesticides. This site scored 29 on HARM.

6.0 RECOMMENDATIONS

The information gathered through interviews and research were sufficient to locate and categorize the onbase disposal sites. A Phase II monitoring program is recommended to accomplish the following objectives:

1. Obtain information regarding aquifer characteristics below PAFB. Such information would include stratigraphy, direction of ground water flow, and permeability.
2. Determine the nature and extent of surface water, ground water, soil, and sediment contamination that might have resulted from past storage, handling, and disposal practices.

In addition, recommendations are made regarding facilities and procedures currently utilized in the handling, storage, and disposal of hazardous materials.

6.1 PHASE II MONITORING RECOMMENDATIONS

The following actions are recommended to further assess the potential for environmental contamination from waste disposal areas at PAFB. The recommended actions are intended to be used as a general guide in the development and implementation of the Phase II study. The recommendations include the approximate number of ground water monitoring wells, type(s) of samples to be collected (e.g., soil, water, sediment) and suspected contaminants for which analyses should be performed. The number of ground water monitoring wells recommended corresponds to the number of wells required to adequately determine whether contaminants are migrating from a given source. The final number of ground water monitoring wells required to determine the extent of and define the movement of contaminants from each site will be determined as part of the Phase II investigation.

Recommended ground water monitoring should be performed periodically in order to assess contaminant migration under different precipitation regimes. After one year of monitoring, the data should be evaluated to determine the need for further action (if any). All drilling activities

should be conducted by a licensed water well driller. All monitor wells should be constructed of threaded-joint casing and factory-slotted screen. Under no circumstances should PVC primer or PVC glue be used for the construction of well casing or bailers. The wells should be installed to the depth of bedrock, and the screen should extend over the entire saturated interval and approximately 1 ft above the water table. The wells need to be screened above the water table to detect nonmiscible, floating contaminants, such as petroleum products. Borehole geophysical logging of all PAFB wells is recommended to facilitate stratigraphic analysis. During drilling, Shelby tube samples should be taken to provide soils data and vertical permeability measurements. The top of the filter pack should be bentonite-sealed, and the annulus should be grouted to the surface. The well should be protected with pipe fitted with locking caps. The well should be developed to the fullest extent possible and surveyed both vertically and horizontally by a registered surveyor to obtain accurate well location distances and water level elevations. Water levels should be measured after recovery from well development and at the time of sampling. Slug tests should be conducted to determine horizontal permeability and to provide data for evaluation of flow rates.

Prior to initiation of any Phase II field activities, a detailed work plan should be prepared. This work plan should provide specific procedures to be followed in well construction, well logging, well installation, well development, surveying, water level measurements, aquifer testing, sampling, laboratory analysis, quality control, and reporting. All water samples should be analyzed at a minimum for total petroleum hydrocarbons, halogenated and nonhalogenated solvents, metals, PCBs, and pesticides, using EPA-approved procedures. The solvent analytes should include at a minimum TCE, benzene, MIBK, carbon tetrachloride, MEK, methylene chloride, and acetone. The metal analytes should include cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc. The recommended parameters include those compounds known or suspected to have been placed in the disposal sites. In addition, certain additional parameters for which drinking water standards exist are included. It is recommended that chemical analysis

for metals include both total and dissolved fractions to quantify which metals are mobile, as well as the total amount of metal sorbed onto suspended materials and, hence, potentially available for leaching. Because the oil and grease analysis by EPA Method 413.2 does not differentiate between extractables of biological origin or the mineral oils and greases of POL origin, the EPA Infrared (IR) Spectrophotometric Method for total recoverable petroleum hydrocarbons (EPA Method 418.1) is recommended for assessing POL contamination. Halogenated and nonhalogenated solvents, PCBs, and pesticides may be analyzed by EPA Methods 624 and 625 or comparable methods. All water samples should be analyzed for pH, conductivity, and oxidation-reduction potential at the time of sampling.

The two landfills adjacent to Sand Creek (Sites 1 and 2) are close together and have similar disposal histories. It is recommended that monitoring in this area examine the aggregate effect of these sites. Initially, three wells should be placed northwest of the sites along Sand Creek, and two wells on the east and south (See Figure 6.1-1). Shallow ground water movement in the area presumably follows the stream channel, so these locations should provide upgradient and downgradient sampling points. In addition, surface water and sediments in Sand Creek should be sampled at the upstream and downstream ends of the reach crossing USAF property. Samples should be taken during high and low flow periods.

For the leach field area (Site 3), it is recommended that composite soil samples be taken from the upper 6 ft of soil by hand augering. In addition, water and sediment sampling should be conducted in the adjacent pond. Well installation may be necessary based on the results of these samples, but should be avoided if possible to limit damage and disruption to the golf course grounds and operations.

Composite soil samples from the upper 6 ft are also recommended for the old Firefighter Training Area (Site 4). Four to 6 sample points spread over the site should be sufficient to assess the extent of contamination present, if any. If significant contamination is found, installation of monitoring wells should be considered.

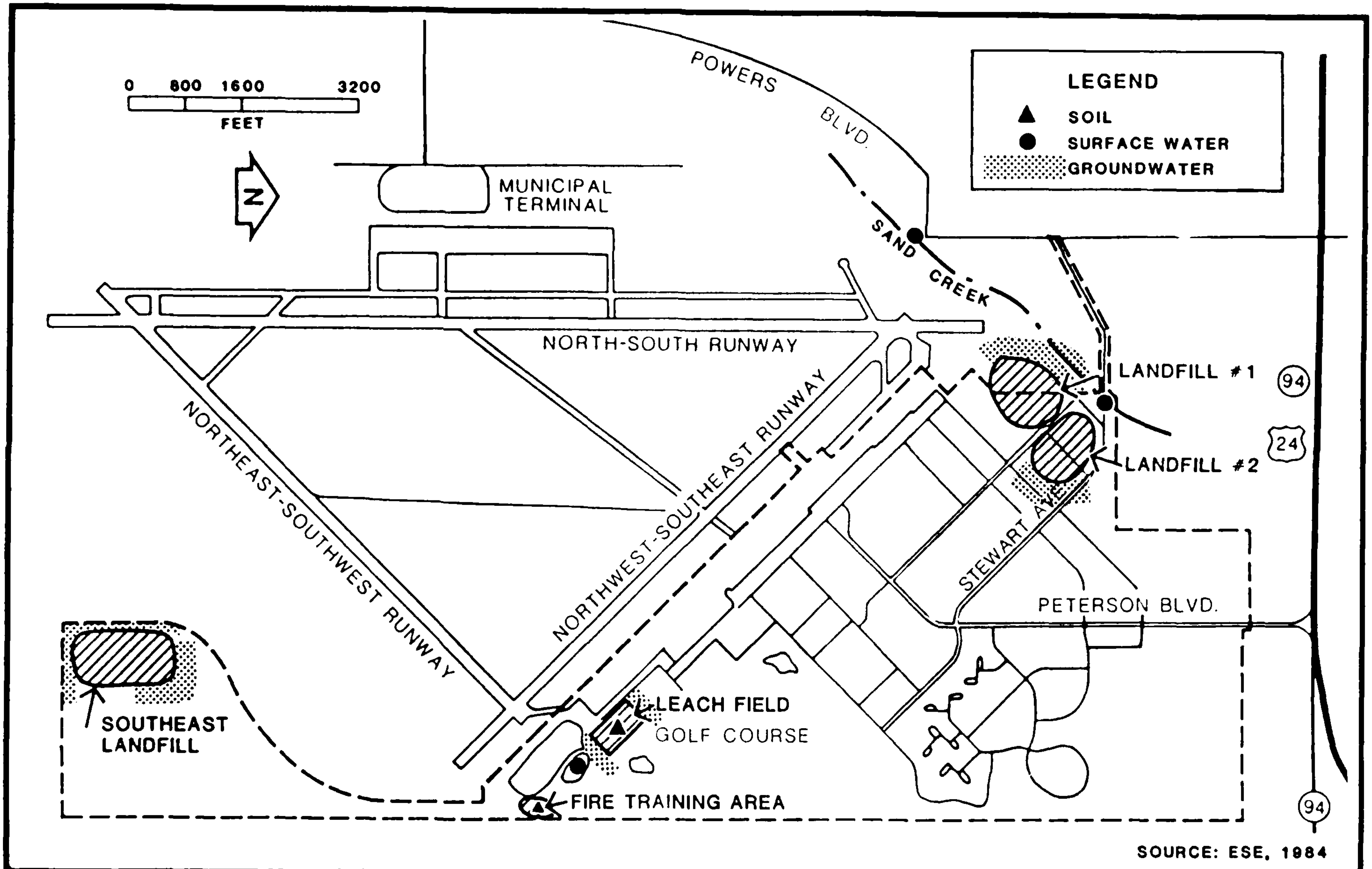


Figure 6.1-1
RECOMMENDED MONITORING LOCATIONS

INSTALLATION
RESTORATION PROGRAM
Peterson Air Force Base

For the Southeast Landfill (Site 5), it is recommended that monitoring wells be established between the site and the boundary and on the northeast, upgradient of the fill area. Preliminary information indicates that shallow ground water may not be present in this area. If boreholes do not encounter water at less than 50 ft, well installation may not be appropriate. In this case, possible methods of vadose zone monitoring should be considered.

Table 6.1-1 summarizes the recommended monitoring for PAFB Phase II investigations.

6.2 EXISTING FACILITIES/PROCEDURES

The site visit and conversations with PAFB engineering personnel identified one area requiring attention to insure regulatory compliance and guard against possible future contamination. When the leach field serving the industrial drain line was removed during construction of the golf course, the line was cut. One building (104) is still connected to this line which apparently discharges into the ground at an unknown location. The line terminals should be located and connected to the sanitary sewer, or all inflow points to it within Building 104 should be rerouted to the sanitary sewer.

6.3 LAND USE GUIDELINES

Careful consideration should be given to the uses made of the disposal areas for the following reasons:

1. To provide the continued protection of human health, welfare, and the environment;
2. To insure that the migration of potential contaminants is not promoted through improper land uses;
3. To facilitate the compatible development of future USAF facilities; and
4. To allow for identification of property which may be proposed for excess or outlease.

In general, activities which would tend to disrupt the waste cells should be avoided so as not to facilitate contaminant migration. Such

Table 6.1-1. Summary of Recommended Monitoring for PAFB Phase II Investigations.

Site	HARM Score	Recommended Sampling	Recommended Analysis
Landfill #1 Landfill #2	59 59	Three wells downgradient; Two wells upgradient; Water and sediment samples from Sand Creek upstream and downstream.	Hydrocarbons, Solvents, Metals, PCB's, Pesticides
East Boundary Leachfield	52	Soil samples to six foot depth (or bottom of pit) in grid over area.	Hydrocarbons, metals
Firefighter Training Area #1	38	Soil samples to six foot depth (or bottom of pit) in grid over pit.	Hydrocarbons, PCB's Pesticides
Southeast Landfill	29	Three boundary wells Two upgradient wells Possible use of vadose zone monitoring.	Hydrocarbons Solvents Metals PCB's Pesticides

Source: ESE, 1984.

activities include foundation and drainage ditch construction. To avoid trapping any volatile compounds that may be released from the disposal areas, structures should not be placed over the sites.

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APPENDIX A

GLOSSARY OF TERMINOLOGY, ABBREVIATIONS, AND ACRONYMS

APPENDIX A
GLOSSARY OF TERMINOLOGY, ABBREVIATIONS, AND ACRONYMS

ADCOM	Aerospace Defense Command
AFAA	Air Force Audit Agency
AFB	Air Force Base
AFFF	Aqueous Film Forming Foam
AFOSI	Air Force Office Special Investigations
AFRES	Air Force Reserve Tactical Airlift Unit
AFS	Air Force Station
AFSSMET	Air Force Special Staff MGT Engineering Team
Alluvium	Unconsolidated material deposited by stream action.
Aquiclude	Geologic unit which impedes ground water flow
Aquifer	A geologic formation, group of formations, or part of a formation capable of yielding water to a well or spring.
ATCT	Air Traffic Control Tower
Cadmium	A metal used in batteries and other inudstrial applications; highly toxic to humans and aquatic life.
Carbon tetrachloride	A solvent commonly in use until the 1960s; a suspected human carcinogen.
Carbonate	A sediment formed by the organic or inorganic precipitation from aquesous solutions of calcium, magnesium and iron.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act

APPENDIX A
(Continued, Page 2 of 6)

Chert	Dense cryptocrystalline sedimentary rock.
Chromium	A metal used in plating, cleaning, and other industrial applications; highly toxic to aquatic life at low concentrations, toxic to humans at higher levels.
Clastic	Sedimentary rock derived from fragments derived from pre-existing rocks.
cm/yr	centimeters per year
COC	Combat Operations Center
Colluvium	Loose material at the base of a steep slope or cliff.
Concretion	Hard, compact material of mineral matter formed by precipitation from aqueous solution.
Confo-mity	Undisturbed relations of strata deposited in order with little or no time lag, continuous.
Contaminated fuel	Fuel which does not meet specifications for recovery or recycle.
Contamination	Degradation of natural water quality to the extent that its usefulness is impared; degree of permissible contamination depends on intended use of water.
DDT	Dichlorodiphenyltrichloroethane, pesticide commonly used in 1960's.
Deposition	The lying down of rock forming material.
Det 4, 1401 MAS	Detachment 4, 1401 Military Airlift Squadron
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DEW	Distant Early Warning
DF-2	Diesel fuel

AD-A168 811 INSTALLATION RESTORATION PROGRAM PHASE I RECORDS SEARCH 2/2
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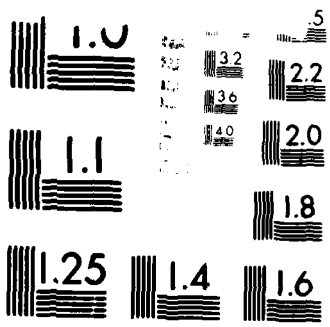
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2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

Disposal of hazardous waste	Discharge, deposit, injection, dumping, spilling, or placing of any hazardous waste into or on land or water so that such waste or any constituent thereof may enter the environment, be emitted into the air, or be discharged into any waters, including ground water.
DOD	Department of Defense
DPDO	Defense Property Disposal Office
Effluent	Liquid waste discharged in its natural state or partially or completely treated from a manufacutring or treatment process.
EPA	U.S. Environmental Protection Agency
Epeiric	Shallow sea conditions on the continental shelf or within the continent.
Erosin	The breakdown of terrestrial material by natural processes.
ESE	Environmental Science and Engineering, Inc.
°F	Degrees Fahrenheit
ft	feet
Ground water	Water beneath the land surface in the saturated zone that is under atmospheric or artesian pressure.
GSA	General Services Administration
HARM	Hazard Assessment Rating Methodology
Hazardous waste	As defined in RCRA, a solid waste or combination of solid wastes which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in

	serious, irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.
in	inches
in/hr	inches per hour
in/yr	inches per year
Infiltration	Movement of water through the soil surface into the ground.
Interformational leakage	Movement of ground water from one aquifer to another due to changes of hydraulic head.
IRP	Installation Restoration Program
JP-4	Jet fuel used in T-37 and T-38 aircraft.
km	kilometers
Lead	A metal additive to gasoline and used in other industrial applications; toxic to humans and aquatic life; bioaccumulates.
Leachate	A solution resulting from the separation or dissolving of soluble or particulate constituents from solid waste or other man-placed medium by percolation of water.
loam	Soil material of varible clay, silt and snad compositions.
MEK	Methyl ethyl ketone, a solvent used in paint thinner, stripper, and a wide variety of industrial applications; suspected to be toxic to humans at high levels; potentially toxic to aquatic life.
Metamorphic	Rocks formed from other rock types due to intense temperature and pressure.

APPENDIX A
(Continued, Page 5 of 6)

mg/l	milligrams per liter
mm	millimeters
MOGAS	motor gasoline
mph	miles per hour
m/sec	meters per second
msl	mean sea level
NCMC	NORAD Cheyenne Mountain Complex
NORAD	North American Aerospace Defense Command
OMS	Organizational Maintenance Squadron
OLJ/CEMIRT	Civil Engineering Maintenance, Inspection, Repair and Training Team
orogeny	uplift
PAFB	Peterson Air Force Base
PCB	Polychlorinated biphenyls, liquid used as a dielectric in electrical equipment; suspected human carcinogen; bioaccumulates in the food chain and causes toxicity to higher trophic levels.
POL	petroleum, oils, lubricants
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
SAC	Strategic Air Command
sedimentary	Rocks formed from consolidation of loose sediment.
SPACECMD	Space Command
Spill	An unplanned release or discharge of a hazardous waste onto or into air, land, or water.

APPENDIX A
(Continued, Page 6 of 6)

TCE	Trichloroethylene, a commonly used degreasing solvent; toxic to aquatic life and a suspected human carcinogen.
TCF	Tactical Control Flight
TRANS	Transportation
unconformity	Break in the depositional record due to uplift and erosion
Upgradient	In the direction of increasing hydraulic static head; the direction opposite to the prevailing flow of ground water.
USAF	U.S. Air Force
USGS	U.S. Geological Survey
USDC	U.S. Department of Commerce
USSCS	U.S. Soil Conservation Service
Water table	Surface of a body of unconfined ground water at which the pressure is equal to that of the atmosphere.
WWII	World War II
1SPACEWG	1st Space Wing

APPENDIX B

TEAM MEMBER BIOGRAPHICAL DATA

BRUCE N. McMASTER, Ph D.
Senior Chemist/Project Manager

ESE PROFESSIONAL RESUME

SPECIALIZATION

Toxic and Hazardous Waste Disposal, Hazardous Waste Site Investigations, Pollutant Fate Studies, Environmental Chemistry, Water Quality

RECENT EXPERIENCE

Records Search for U.S. Army Toxic and Hazardous Materials Agency, Project Manager--Assessing environmental quality of 65 Army installations with regard to the use, storage, treatment and disposal of toxic and hazardous materials; define contaminants present, potential for off-site migration, and potential impacts on receptors; recommend sampling and analysis surveys for quantitative delineation of contamination problems; evaluate compliance status with all applicable environmental regulations.

Environmental Contamination Surveys for the U.S. Army Toxic and Hazardous Materials Agency, Project Manager--Investigating 7 U.S. Army installations to confirm the presence of toxic and hazardous contaminants, and to define the extent of contamination and contaminant migration. Surveys include sampling and analysis of surface waters, ground water, soil, sediments, sewers, and buildings. Conduct alternative analyses for potential mitigative measures.

Initial Assessment Studies for the Naval Energy and Environmental Support Activity, Project Manager--Evaluating 4 Naval installations with regard to past hazardous waste generation, storage, treatment, and disposal practices. Investigations include records review, aerial and ground site surveys, employee interviews, and limited sampling and analysis including geophysical techniques. Determine extent of contamination at former disposal/spill sites, potential for contaminant migration, and potential effects on human health and the environment.

EDUCATION

Post-Doctoral	1977-78	Environmental Engineering/Science	University of Florida
Ph.D.	1976	Chemistry	University of Florida
B.S.	1968	Chemistry	University of Delaware

REGISTRATIONS/ASSOCIATIONS

American Chemical Society, Member
American Defense Preparedness Association, Member

PUBLICATIONS

Approximately 20 hazardous waste site investigations of U.S. military installations.

D-MRIMS.1/BNM-HZ.1
04/27/84

ESE
PROFESSIONAL RESUME

WILLIAM G. FRASER, B.S., P.E.
Senior Associate Engineer

SPECIALIZATION

Water Quality/Resources Engineering, Environmental Impact Assessment, Groundwater Hydrology, Siting and Environmental Studies

RECENT EXPERIENCE

USAF Installation Assessment - Currently evaluating present and historical waste disposal practices at Vance Air Force Base, Oklahoma.

Navy Installation Assessments - Worked as the Environmental Engineer on a project team examining historical waste handling practices and disposal sites at several Naval Bases. Studied waste types and quantities, and assessed disposal site suitability based on hydrogeologic characteristics, neighboring land use, and contaminant migration potential.

Siting Studies - Worked as staff member performing hydrologic, water quality and air quality studies related to siting and licensing of major mining and power facilities.

Field Investigations - Streamflow measurement, water sampling, dam site investigations, and groundwater testing at numerous sites in Colorado and the West.

USATHAMA Installation Assessments - Worked as the Environmental Engineer on a project team examining waste disposal practices at several Army Bases, including Ft. Carson, Colorado. Examined various industrial operations and an industrial waste treatment plant handling oily wastewater.

USATHAMA Environmental Survey - Evaluated the nature and extent of contaminant migration from abandoned landfill sites containing solvents, POL, pesticides, and medical supplies. Reviewed surface and groundwater analytical data and calculated pollutant mass influx at installation boundary based on surface runoff and groundwater flow.

EDUCATION

B.S.	1975	Civil/Environmental Engineering	University of Connecticut

REGISTRATION

Registered Professional Engineer, State of Colorado, 1983

ASSOCIATIONS

American Society of Civil Engineers
American Water Resources Association

ESE
PROFESSIONAL RESUME

KATHRYN L. KAWECKI, B.S.
Associate Scientist

SPECIALIZATION

Hazardous Waste Site Assessment, Geology, Oil and Gas Exploration, Paleoenvironmental Modeling, Well Site Geology, Friction Material Analysis, Biology

RECENT EXPERIENCE

Installation Restoration Program, Team Geologist--Identification and evaluation of hazardous material disposal sites on various Air Force Base's in the western region. Develop a program for the control of contaminant migration and eliminate public health hazards that may result from past operations.

Toxic and Hazardous Contamination Evaluation, Team Geologist--Field reconnaissance and assessment of offpost Rocky Mountain Arsenal related ground water contamination. Evaluation of possible significance to public health.

Husky Oil Company, Exploration Geologist--Responsible for geologic interpretations and evaluations in assigned areas and projects. Prepared and executed geologic programs (subsurface and surface mapping, seismic recommendations, and land checks) to locate and test economically viable exploration and explortation opportunities for development of new company reserves. Areas of exploration included: Nebraska, Kansas, North Dakota, Wyoming, and Texas.

Champlin Petroleum, Junior Geologist--Responsible for regional studies on the North Slope of Alaska and the Big Horn Basin in Wyoming.

Bendix Research Laboratory, Student Engineer--Qualitative and quantitative chemical analysis of industrial materials pertinent to company's products. Normal laboratory skills include experience with specialized instruments.

EDUCATION

B.S.	1981	Geology	University of Michigan

AFFILIATIONS

Rocky Mountain Association of Geologists
American Association of Petroleum Geologists

PUBLICATIONS

University of Michigan Departmental Report on a research project involving the utilization of calcite twin analysis to reconstruct the stress and strain history of a thrust street in the Wyoming Thrust Belt.

KLK/HZ/0884.1
08/13/84

ESE PROFESSIONAL RESUME

DAVID H. STEPHENS, B.S.
Associate Scientist

SPECIALIZATION

Geologic Evaluations, Geophysical/Geochemical Techniques, Hazardous Waste Site Assessment, Hydrology

RECENT EXPERIENCE

Toxic and Hazardous Materials Assessment Study, Team Geologist--Geologic and hydrologic study of offpost contamination in the area of the Rocky Mountain Arsenal, Denver, Colorado. Tasks included inventory and compilation of geologic and ground water data base, design and maintenance of ground water monitoring and sampling network, and development of subsurface geologic models to aid in the location of additional test borings and construction of hydrologic models.

Geologic and Geohydrologic Evaluation of Air Force Facilities, Team Geologist--Phase I records search as part of installation restoration program. Installations include Laughlin Air Force Base, Del Rio, Texas and Goodfellow Air Force Base, San Angelo, Texas.

Uranium Exploration, Development Drilling, Project Manager--Responsible for entire project management including safety and reclamation activities. Included supervision and monitoring of refuse and waste disposal at onsite locations and compliance with state and federal regulations regarding radioactive materials.

EDUCATION

B.S.	1975	Geological Sciences	LeHigh University

ASSOCIATIONS

American Association of Petroleum Geologists--Energy Minerals Division
Society of Mining Engineers of AIME

DHS/HZ/0884.1
08/13/84

APPENDIX C

LIST OF INTERVIEWEES AND OUTSIDE CONTACTS

APPENDIX C
LIST OF INTERVIEWEES

Position	Years of Service
Heavy Equipment Operator	28
Heavy Equipment Operator	25
Foreman Entomology	27
Superintendent Grounds	18
Contract Programmer	28
Planning Chief	25
Deputy Base CE	27
NCOIC, Paint Shop	1
Foreman, Paint Shop	3
Assistant Supervisor, Vehicle Maintenance	3
Foreman, Paint Shop	2
Foreman, Pneudralics	2
Civil Engineer	2
Superintendent	3
Contractor	20
Chief, BEE	1
NCOIC, BEE	2
Fuels	5
Fire Chief	10
Environmental Specialist	
Chief, Aircraft Systems	15
Historian	1
Personnel, JAM	4
Personnel, Weather	2
NCMC DEEV	2

APPENDIX C
LIST OF OUTSIDE CONTACTS
(Page 2 of 2)

U.S. Geolgoical Survey Library
Box 25046, Denver Federal Center
Denver, Colorado
(303) 234-4183

Colorado Department of Natural Resources
Division of Water Resources
1313 Sherman Street
Denver, Colorado
(303) 866-3587

Colorado School of Mines Library
1500 Illinois Street
Golden, Colorado
(303) 273-3800

Intercouncil of Government of Colorado Springs
Mike Anderson
2700 East Vermajo
Colorado Springs, Colorado
(303) 471-7080

Colorado Springs Planning Department
Bob Rockhen
P.O. Box 1575
Colorado Springs, Colorado
(303) 578-6692

El Paso County Land Use and Planning Department
Mr. Kim Hedly
27 E. Vermajo
Colorado Springs, Colorado
(303) 471-5742

Security Water District
Bob Schafer
P.O. Box 5156
Security, Colorado
(303) 392-3475

APPENDIX D

MASTER LIST OF SHOPS

APPENDIX D
MASTER LIST OF SHOPS

Facility	Building Number	Handles Hazardous Materials	Materials Handled	Produces Hazardous Waste
901st				
AGE	130	Yes	PD-680	No
Corrosion Control	625	Yes	Paints, thinners, etc.	Yes
Fuel System	1104	Yes	MEK	No
NDI	538	Yes	Penetrant	No
Engine Shop	502	Yes	Carbon Remover	Yes
Repair and Reclamation	114	Yes	PD-680	No
Electronic Shop	625	Yes	Electrolyte	No
Environmental Sytems	625	Yes	PD-680, carbon remover	Yes
Pneudraulics	625	Yes	PD-680, carbon remover	Yes
1st Space Support Group				
AGE	503	Yes	PD-680, carbon remover	Yes
Electric Shop	625	Yes	Electrolyte	No
PMEL	504	Yes	Cesium source mercury	No
Pneudraulics	625	Yes	PD-680, carbon remover	Yes
Repair and Reclamation	103	Yes	PD-680	No

APPENDIX D
MASTER LIST OF SHOPS
(Continued, Page 2 of 3)

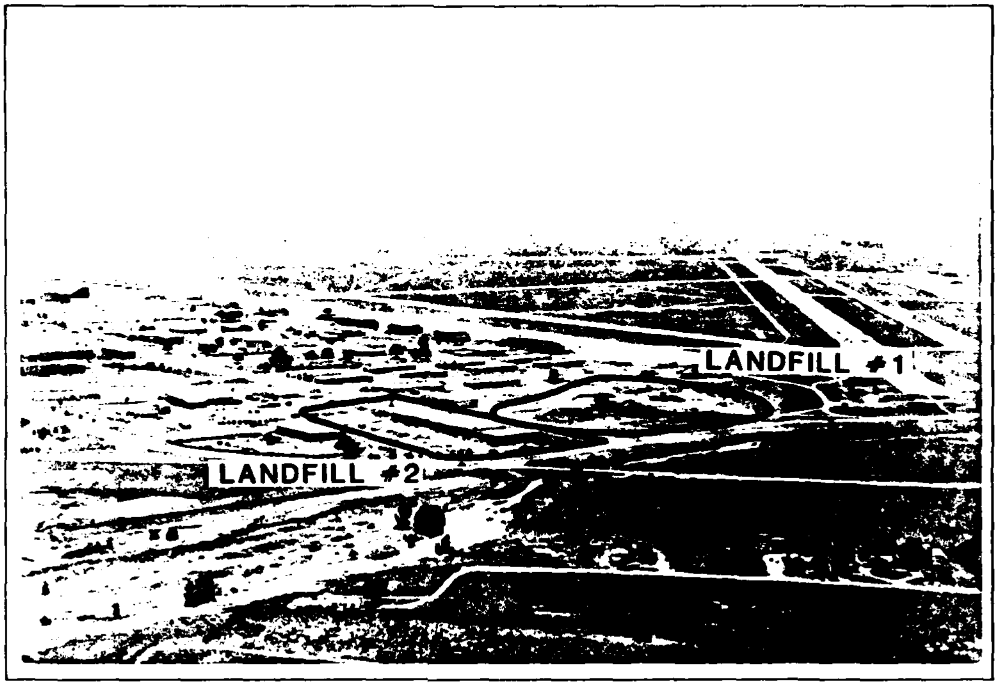
Facility	Building Number	Handles Hazardous Materials	Materials Handled	Produces Hazardous Waste
1001st Transportation				
Allied Trades	1255	Yes	Paints, lacquers, etc.	Yes
General Maintenance	1255	Yes	PD-680, lube oil	No
Minor Maintenance	1255	Yes	Electrolyte	No
1001st CES				
Entomology	1324	Yes	Pesticides	No
Fire Department	117	Yes	AFFF Foam	No
Golf Course Maintenance	206	Yes	Herbicides, PD-680	No
Heating Shop	1324	Yes	Antifreeze	No
Paint Shop	1324	Yes	Paints, thinners, etc.	Yes
Heavy Equipment	1322	Yes	PD-680	No
1001st SPS				
Firing Range		Yes	Lead, PD-680	No
1st Space Support Group				
Audiovisual Laboratory	418	Yes	Photo waste	No
1001st Supply				
Fuel Quality	667	Yes	Waste POL	No

APPENDIX D
MASTER LIST OF SHOPS
(Continued, Page 3 of 3)

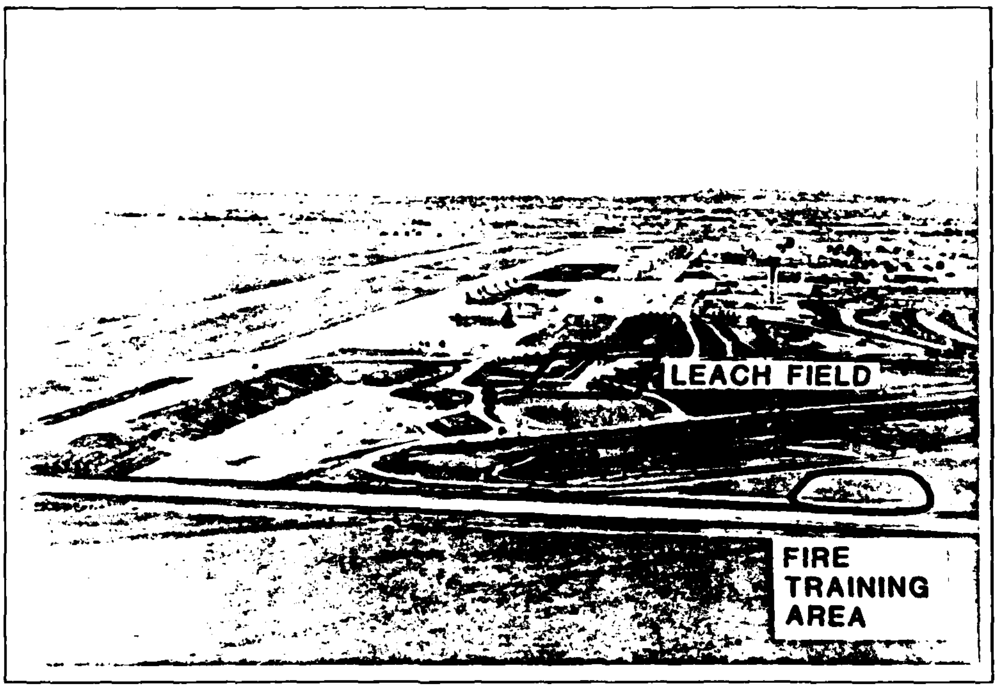
Facility	Building Number	Handles Hazardous Materials	Materials Handled	Produces Hazardous Waste
USAF Clinic				
Dental Clinic	959	Yes	Photo Waste	No
Dental Laboratory		Yes	Chloroform	No
Medical Laboratory		Yes	Acids and reagents	No
X-Ray		Yes	Photo Waste	No
MWR				
Auto Hobby	640	Yes	PD-680, paints thinners, waste POL	Yes
NCMC				
Photo	640	Yes	Photo waste	No
Power	12132	Yes	Waste POL	Yes
Facilities	6045	Yes	TCE, MEK	Yes

APPENDIX E

PHOTOGRAPHS OF DISPOSAL/SPILL SITES



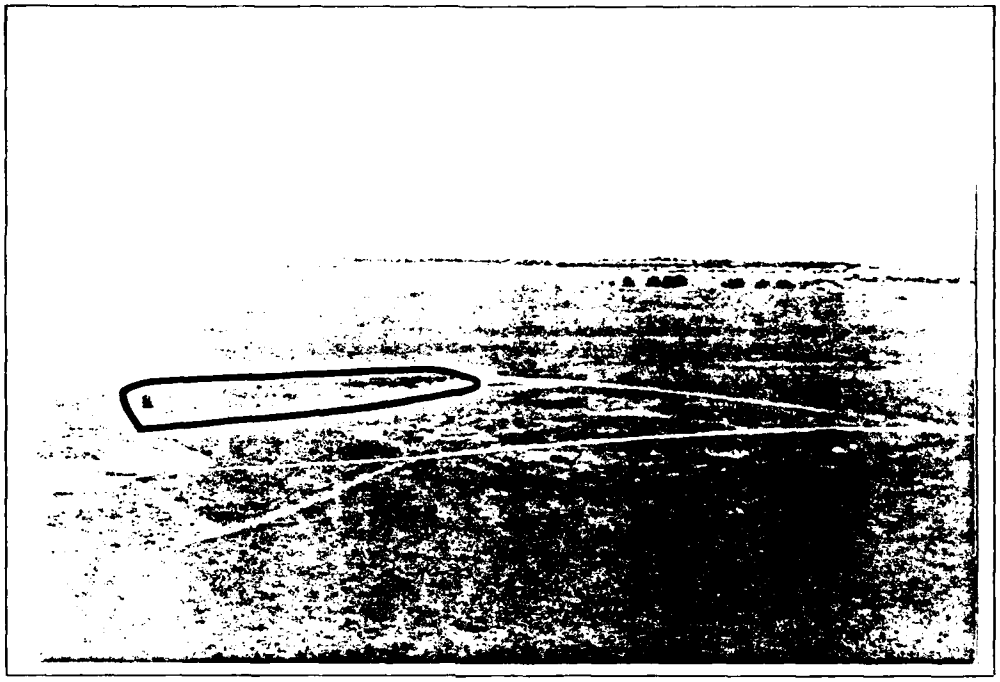
LANDFILL #1 AND #2



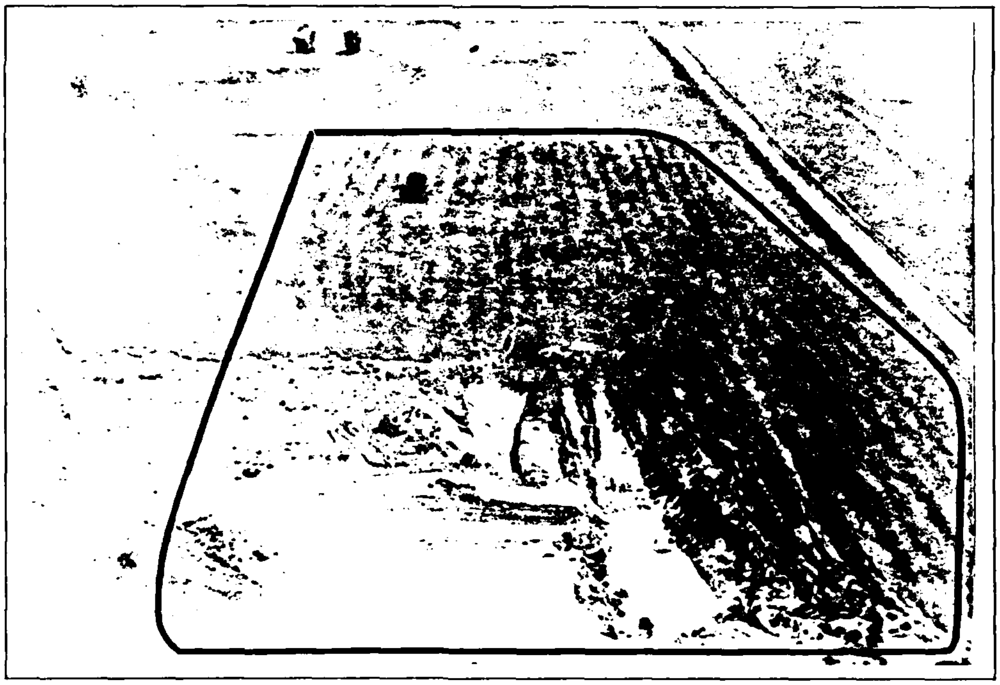
LEACH FIELD AND FIRE TRAINING AREA

AREAS OF POTENTIAL CONTAMINATION

INSTALLATION RESTORATION PROGRAM
Peterson Air Force Base



SOUTHEAST LANDFILL



SOUTHEAST LANDFILL

AREAS OF POTENTIAL CONTAMINATION

INSTALLATION RESTORATION PROGRAM
Peterson Air Force Base

APPENDIX F

USAF IRP HAZARD ASSESSMENT RATING METHODOLOGY

USAF INSTALLATION RESTORATION PROGRAM
HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

The Department of Defense (DOD) has established a comprehensive program to identify, evaluate, and control problems associated with past disposal practices at DOD facilities. One of the actions required under this program is to:

> "develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts." (Reference: DEQPPM 81-5, 11 December 1981).

Accordingly, the United States Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the Records Search phase of its Installation Restoration Program (IRP).

The first site rating model was developed in June 1981 at a meeting with representatives from USAF Occupational Environmental Health Laboratory (OEHL), Air Force Engineering Services Center (AFESC), Engineering-Science (ES) and CH_2M Hill. The basis for this model was a system developed for EPA by JRB Associates of McLean, Virginia. The JRB model was modified to meet Air Force needs.

After using this model for 6 months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF OEHL, AFESC, various major commands, Engineering Science, and CH_2M Hill met to address the inadequacies. The result of the meeting was a new site rating model designed to present a better picture of the hazards posed by sites at Air Force installations. The new rating model described in this presentation is referred to as the Hazard Assessment Rating Methodology.

PURPOSE

The purpose of the site rating model is to provide a relative ranking of sites of suspected contamination from hazardous substances. This model will assist the Air Force in setting priorities for follow-on site investigations and confirmation work under Phase II of IRP.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazardous wastes present in sufficient quantity), and (2) potential for migration exists. A site can be deleted from consideration for rating on either basis.

DESCRIPTION OF MODEL

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DOD program needs.

The model uses data readily obtained during the Record Search portion (Phase I) of the IRP. Scoring judgments and computations are easily made. In assessing the hazards at a given site, the model develops a score based on the most likely routes of contamination and the worst hazards at the site. Sites are given low scores only if there are clearly no hazards at the site. This approach meshes well with the policy for evaluating and setting restrictions on excess DOD properties.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination, the waste and its characteristics, potential pathways for waste contaminant migration, and any efforts to contain the contaminants. Each of these categories contains a number of rating factors that are used in the overall hazard rating.

The receptors category rating is calculated by scoring each factor, multiplying by a factor weighting constant and adding the weighted scores to obtain a total category score.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned and for direct evidence 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. These routes are surface water migration, flooding, and ground-water migration. Evaluation of each route involves factors associated with the particular migration route. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The scores for each of the three categories are then added together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Sites at which there is no containment are not reduced in score. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste managment practices category factor to the sum of the scores for the other three categories.

HAZARD ASSESSMENT RATING METHODOLOGY FLOW CHART

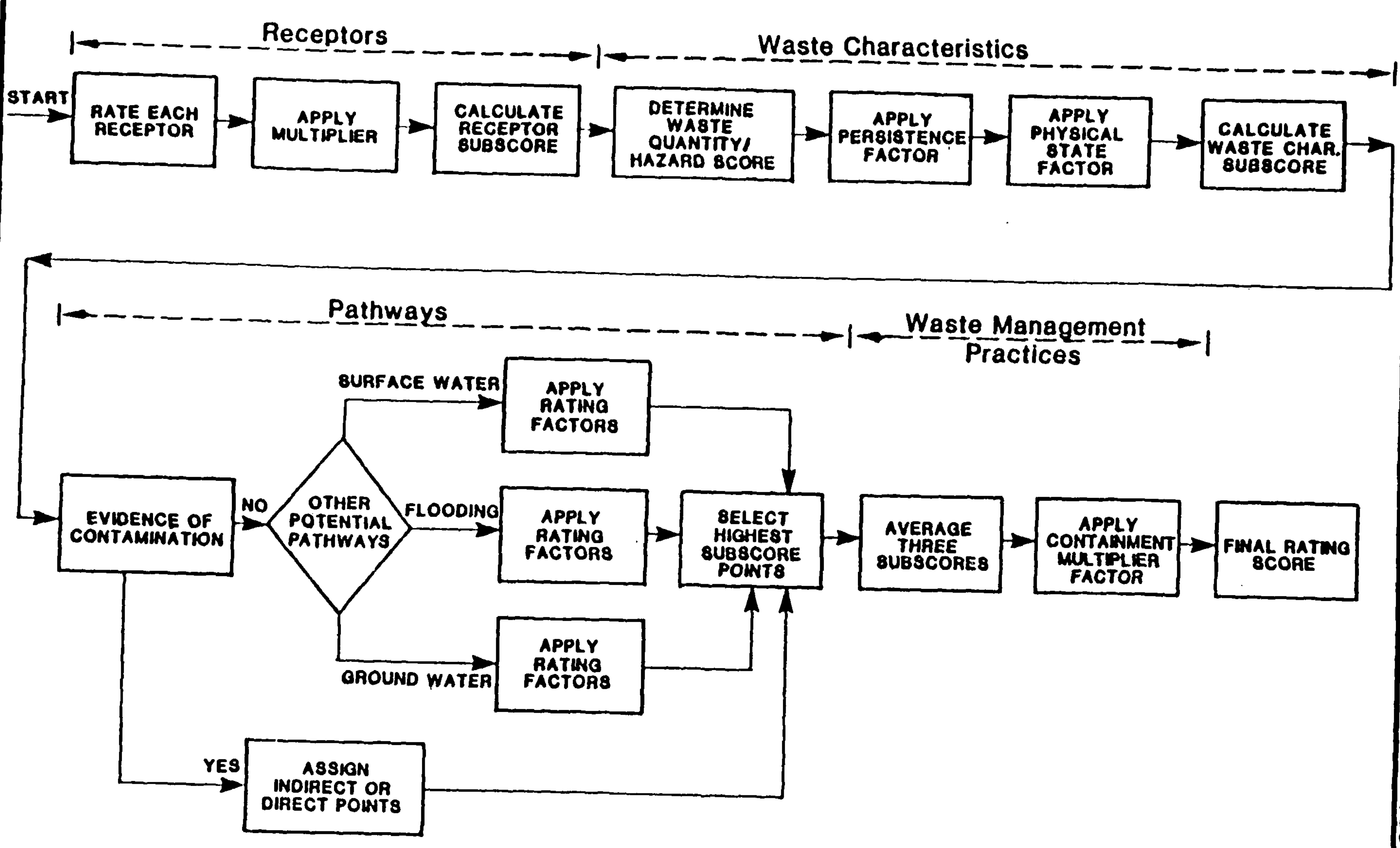


FIGURE 1

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE ____________________

LOCATION ____________________

DATE OF OPERATION OR OCCURRENCE ____________________

OWNER/OPERATOR ____________________

COMMENTS/DESCRIPTION ____________________

SITE RATED BY ____________________

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site		4		
B. Distance to nearest well		10		
C. Land use/zoning within 1 mile radius		3		
D. Distance to reservation boundary		6		
E. Critical environments within 1 mile radius of site		10		
F. Water quality of nearest surface water body		6		
G. Ground water use of uppermost aquifer		9		
H. Population served by surface water supply within 3 miles downstream of site		6		
I. Population served by ground-water supply within 3 miles of site		6		
		Subtotals	______	______

Receptors subscore (100 X factor score subtotal/maximum score subtotal) ______

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) ______
2. Confidence level (C = confirmed, S = suspected) ______
3. Hazard rating (H = high, M = medium, L = low) ______

Factor Subscore A (from 20 to 100 based on factor score matrix) ______

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

______ X ______ = ______

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

______ X ______ = ______

FIGURE 2 (Continued)

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		
		Subtotals	______	______

Subscore (100 X factor score subtotal/maximum score subtotal) ______

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		

Subscore (100 x factor score/3) ______

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		
		Subtotals	______	______

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors ______
Waste Characteristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

______ X ______ = ______

TABLE 1

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels: 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1 - 25	26 - 100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land Use/Zoning (within 1 mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1 mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination.	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands.	10
F. Water quality/use designation of nearest surface water body	Agricultural or industrial use.	Recreation, propagation and management of fish and wildlife.	Shellfish propagation and harvesting.	Potable water supplies	6
G. Ground-Water use of uppermost aquifer	Not used, other sources readily available.	Commercial, industrial, or irrigation, very limited other water sources.	Drinking water, municipal water available.	Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available.	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1 - 50	51 - 1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1 - 50	51 - 1,000	Greater than 1, 000	6

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

S = Small quantity (<5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (>20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- o Verbal reports from interviewer (at least 2) or written information from the records.
- o Knowledge of types and quantities of wastes generated by shops and other areas on base.
- o Based on the above, a determination of the types and quantities of waste disposed of at the site.

S = Suspected confidence level

- o No verbal reports or conflicting verbal reports and no written information from the records.
- o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site.

A-3 Hazard Rating

Hazard Category	Rating Scale Levels 0	1	2	3
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2	Sax's Level 3
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS (Continued)

Waste Characteristics Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
80	L	C	M
	M	C	H
70	L	S	H
60	S	C	H
	M	C	M
50	L	S	M
	L	C	L
	M	S	H
	S	C	M
40	S	S	H
	M	S	M
	M	C	L
	L	S	L
30	S	C	L
	M	S	L
	S	S	M
20	S	S	L

Notes:
For a site with more than one hazardous waste, the waste quantities may be added using the following rules:
Confidence Level
- o Confirmed confidence levels (C) can be added
- o Suspected confidence levels (S) can be added
- o Confirmed confidence levels cannot be added with suspected confidence levels

Waste Hazard Rating
- o Wastes with the same hazard rating can be added
- o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Persistence Criteria	Multiply Point Rating From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical State	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION

Rating Factor	Rating Scale Levels 0	1	2	3	Multiplier
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 in.	-10 to + 5 in.	+5 to +20 in.	Greater than +20 in.	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1 year 24-hr rainfall	<1.0 inch	1.0-2.0 inches	2.1-3.0 inches	>3.0 inches	8

B-2 POTENTIAL FOR FLOODING

Rating Factor	0	1	2	3	Multiplier
Floodplain	Beyond 100-year floodplain	In 25-year floodplain	In 10-year floodplain	Floods annually	1

B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION

Rating Factor	0	1	2	3	Multiplier
Depth to ground water	Greater than 500 ft	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 in.	-10 to +5 in.	+5 to +20 in.	Greater than +20 in.	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. WASTE MANAGEMENT PRACTICES FACTOR

The following multipliers are then applied to the total risk points (from A):

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- o Clay cap or other impermeable cover
- o Leachate collection system
- o Liners in good condition
- o Adequate monitoring wells

Spills:

- o Quick spill cleanup action taken
- o Contaminated soil removed
- o Soil and/or water samples confirm total cleanup of the spill

Surface Impoundments:

- o Liners in good condition
- o Sound dikes and adequate freeboard
- o Adequate monitoring wells

Fire Proection Training Areas:

- o Concrete surface and berms
- o Oil/water separator for pretreatment of runoff
- o Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1 or III-B-3, then leave blank for calculation of factor score and maximum possible score.

APPENDIX G

HAZARD ASSESSMENT RATING METHODOLOGY FORMS

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: East Fork Sand Creek Landfill #1

Location: 400' FNL & 2,600' FWL

Date of Operation or Occurrence: 1953 - 1954

Owner/Operator: USAF Peterson AFB

Comments/Description: Sanitary Waste Disposal Pit (45'-60' Deep)

Site Rated By: K.L. Kawecki - D.H. Stephens

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1-mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1-mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground water supply within 3 miles of site	3	6	18	18
SUBTOTALS			106	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				59

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) S
2. Confidence level (1=confirmed, 2=suspected) C
3. Hazard rating (1=low, 2=medium, 3=high) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor:
Factor Subscore A x Persistence Factor = Subscore B
50 x 1.0 = 50

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore
50 x .75 = 37

HAZARD ASSESSMENT RATING METHODOLOGY FORM
(Continued, Page 2 of 2)

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists, proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for three potential pathways: surface water migration, flooding, and ground water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
SUBTOTALS			46	108
Subscore (100 x factor score subtotal/maximum score subtotal)				43
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	3	8	24	24
Direct access to ground water	0	8	0	24
SUBTOTALS			56	114
Subscore (100 x factor score subtotal/maximum score subtotal)				49

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	59
Waste Characteristics	37
Pathways	80
TOTAL	176 divided by 3 = 59 Gross total score

B. Apply factor for waste containment from waste management practices. Gross total score x waste management practices factor = final score.

59 x 1.0 = 59

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: East Fork Sand Creek Landfill #2

Location: 500' FNL & 2,600' FWL

Date of Operation or Occurrence: 1954 - 1961

Owner/Operator: USAF Peterson AFB

Comments/Description: Sanitary Waste Disposal Pit (45' Deep)

Site Rated By: K.L. Kawecki - D.H. Stephens

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1-mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1-mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground water supply within 3 miles of site	3	6	18	18
SUBTOTALS			106	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 59

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) S
2. Confidence level (1=confirmed, 2=suspected) C
3. Hazard rating (1=low, 2=medium, 3=high) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor:
Factor Subscore A x Persistence Factor = Subscore B
50 x 1.0 = 50

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore
50 x .75 = 37

HAZARD ASSESSMENT RATING METHODOLOGY FORM
(Continued, Page 2 of 2)

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists, proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for three potential pathways: surface water migration, flooding, and ground water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	3	6	18	18
Rainfall intensity	1	8	8	24
SUBTOTALS			58	108
Subscore (100 x factor score subtotal/ maximum score subtotal)				54
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	3	8	24	24
Direct access to ground water	0	8	0	24
SUBTOTALS			56	114
Subscore (100 x factor score subtotal/ maximum score subtotal)				49

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	59	
Waste Characteristics	37	
Pathways	80	
TOTAL	176	divided by 3 = 59 Gross total score

B. Apply factor for waste containment from waste management practices. Gross total score x waste management practices factor = final score.

59 x 1.0 = 59

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Fire Training Area #1
Location: 5,800' FEL and 690' FEL
Date of Operation or Occurrence: 1954 - 1975
Owner/Operator: USAF Peterson AFB
Comments/Description: Site for open burning and training
Site Rated By: K.L. Kawecki - D.H. Stephens

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1-mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1-mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground water supply within 3 miles of site	2	6	12	18
SUBTOTALS			55	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				31

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) M
2. Confidence level (1=confirmed, 2=suspected) C
3. Hazard rating (1=low, 2=medium, 3=high) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor:
Factor Subscore A x Persistence Factor = Subscore B
60 x 0.8 = 48

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore
48 x 1.0 = 48

HAZARD ASSESSMENT RATING METHODOLOGY FORM
(Continued, Page 2 of 2)

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists, proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for three potential pathways: surface water migration, flooding, and ground water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
SUBTOTALS			24	108
Subscore (100 x factor score subtotal/maximum score subtotal)				22
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
SUBTOTALS			40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 35

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors 31
Waste Characteristics 48
Pathways 35
TOTAL 114 divided by 3 = 38 Gross total score

B. Apply factor for waste containment from waste management practices. Gross total score x waste management practices factor = final score.

38 x 1.0 = 38

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Southeast Landfill

Location: 650' FSL and 1,250' FEL

Date of Operation or Occurrence: 1962 - 1975

Owner/Operator: USAF Peterson AFB

Comments/Description: Sanitary waste disposal - cut & fill

Site Rated By: K.L. Kawecki - D.H. Stephens

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1-mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1-mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground water supply within 3 miles of site	2	6	12	18
SUBTOTALS			55	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 31

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) L
2. Confidence level (1=confirmed, 2=suspected) S
3. Hazard rating (1=low, 2=medium, 3=high) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor:
Factor Subscore A x Persistence Factor = Subscore B
50 x 0.8 = 40

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore
40 x 0.50 = 20

HAZARD ASSESSMENT RATING METHODOLOGY FORM
(Continued, Page 2 of 2)

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists, proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for three potential pathways: surface water migration, flooding, and ground water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
SUBTOTALS			24	108
Subscore (100 x factor score subtotal/maximum score subtotal)				22
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
SUBTOTALS			40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 35

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	31
Waste Characteristics	20
Pathways	35
TOTAL	86 divided by 3 = 29 Gross total score

B. Apply factor for waste containment from waste management practices. Gross total score x waste management practices factor = final score.

29 x 1.0 = 29

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: East Boundary Leach Field

Location: 550' FEL and 4,950' FSL

Date of Operation or Occurrence: 1943 - 1978

Owner/Operator: USAF Peterson AFB

Comments/Description:

Site Rated By: K.L. Kawecki - D.H. Stephens

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1-mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1-mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground water supply within 3 miles of site	2	6	12	18
SUBTOTALS			59	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				33

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) L
2. Confidence level (1=confirmed, 2=suspected) C
3. Hazard rating (1=low, 2=medium, 3=high) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor:
Factor Subscore A x Persistence Factor = Subscore B
80 x 1.0 = 80

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore
80 x 1.0 = 80

HAZARD ASSESSMENT RATING METHODOLOGY FORM
(Continued, Page 2 of 2)

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists, proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for three potential pathways: surface water migration, flooding, and ground water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
SUBTOTALS			24	108
Subscore (100 x factor score subtotal/maximum score subtotal)				22
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	3	8	24	24
Subsurface flows	1	8	8	24
Direct access to ground water	0	8	0	24
SUBTOTALS			48	114
Subscore (100 x factor score subtotal/maximum score subtotal)				42

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 42

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	33
Waste Characteristics	80
Pathways	42
TOTAL	155

TOTAL 155 divided by 3 = 52 Gross total score

B. Apply factor for waste containment from waste management practices. Gross total score x waste management practices factor = final score.

52 x 1.0 = 52

END
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